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Problems in Mechanical Drawing

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and Editor of "Manual Training Magazine."

WITH

DRAWINGS BY FRED D. CRAWSHAW, B. S., M. E.

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FOREWORD

This book is a collection of problems for the use of students beginning the subject of mechanical drawing. Each problem is stated but its solution is not given, except in a few cases where experience in teaching has shown that the solution is needed by the student.

The book covers the ground of a first-year high school course, but the first part of it is not too difficult for pupils of the upper grammar grades, especially if the inking be omitted. The book is intended for use under a trained teacher, and is not a text to teach drawing without the help of a teacher.

The problems are divided into groups, each group being intended for use in teaching an important division of the subject; and in each group the problems are arranged approximately in the order of their difficulty in solution.

The teacher will find it convenient to have a model of each of the forms represented in the first two or three groups for use in giving individual instruction to students who fail to understand the problems as given, though with rare exceptions the small sketch in the right-hand upper corner of the sheet will serve as a good substitute for the model.

The formation of correct habits in penciling is the key to success in learning mechanical drawing, and the teacher must do everything in his power to insure this result very

early in the course. Laxity or delay in this respect means the formation of bad habits, which must be inhibited later if the student is ever to become a good draughtsman, and this inhibiting process is a most uneconomical and unpleasant one for both student and teacher.

Only a few of the problems are original with the author; they have been collected through years of experience in teaching the subject and directing others in such teaching. The author desires to acknowledge his indebtedness to Professor Gardner C. Anthony, whose textbook on the "Elements of Mechanical Drawing" has furnished several valuable suggestions, also to Frank E. Mathewson, author of "Notes for Mechanical Drawing." Several of the problems, however, which seem to have been taken directly from one of the above books were in use by the author before these books were published. Indeed many of them have long been the common inheritance of teachers of mechanical drawing. But especially is the author indebted to his co-workers at Bradley Polytechnic Institute who have co-operated with him in developing the book, and to Professor Crawshaw for inking in the drawings and penciling many of them. Without his help this book would have been impossible at the present time.

CHARLES A. BENNETT.

LIST OF PLATES

1— IA—Rectangular Frame.
2— IA—Rectangular Frame, showing pencil lines.
3— IA—Rectangular Frame, completed sheet.
4— IB—Triangular Frame.
5— IB—Triangular Frame, showing pencil lines.
6— IC—Try Square.
7— ID—Shelf.
8— IE—Dovetail Ways.
9— IF—Box.
10— IG—Box—perspective sketch.
11— IH—Box - cabinet projection.
12— IJ—Selected Object—Straight Lines.
13— IIA—Ring.
14— IIB—Picture Frame.
15— IIC—Flower Pot.
16— IID—Circular Box.
17— IIE—Spool.
18— IIF—Cylinder Head.
19— IIG—Selected Object—Circles.
20— IIIA—Torus.
21— IIIB—Face Plate.
22— IIIC—Face Plate.
23— IIID—Crank.
24— IIIE—Gland.
25— IIIF—Bench Shaft Box.
26— IIIG—Link.
27— IIIH—Selected Object—Tangents.
28— IVA—Relation of Views.
29— IVB—Octagonal Plinth.
30— IVC—Hexagonal Plinth.
31— IVD · Hexagonal Prism.
32— IVE—Truncated Hexagonal Prism.
33— IVF—Octagonal Pyramid.
34— IVG—Triangular Pyramid.
35— IVH—Projection Test Problems.
36— VA—Cube.
37— VB—Square Pyramid.
38— VC—Triangular Prism.
39— VD—Square Prism.
40— VE—Angle Block.
41— VF—Hexagonal Prism.
42— VG—Triangular Pyramid.
43— VH—Pentagonal Prism.
44— VJ—Triangular Prism.

45— VK—Sections of Hexagonal Pyramid.
46— VL—Sections of Pentagonal Pyramid.
47— VM—Test Problems in Revolutions.
48— VIA—Truncated Square Prism, face front.
49— VIB—Truncated Square Prism, corner front.
50— VIC—Truncated Hexagonal Prism.
51— VID—Truncated Triangular Prism.
52— VIE—Truncated Square Prism, side at 60°.
53— VIF—Truncated Triangular Prism.
54 - VIG—Wedge.
55— VIH—Model of Waste Basket.
56— VIJ—Truncated Square Pyramid, corner front.
57— VIK—Truncated Square Pyramid, face front.
58— VIL—Oblique Square Pyramid.
59— VIM—Truncated Oblique Pentagonal Pyramid.
60— VIN—Oblique Pentagonal Pyramid.
61— VIIA—Truncated Cylinder, showing pencil lines.
62— VIIB—Truncated Cylinder.
63— VIIB—Truncated Cylinder, showing pencil lines.
64— VIIC—Cone.
65— VIID—Tin Cup.
66— VIIE—Tin Pan.
67— VIIF—Grocer's Funnel.
68— VIIG—Funnel.
69— VIIH—Truncated Cone.
70— VIIJ—Stove Pipe Elbow.
71— VIIK—Scale Scoop.
72— VIIIA—Conic Sections.
73— VIIIB—Intersecting Cylinders, axes intersecting.
74— VIIIC Intersecting Cylinders, axes not intersecting.
75— VIIID—Intersecting Cylinders, at angle of 45°.
76— VIIIE—Intersecting Square Pyramid, and Square Prism.
77 - VIIIF—Intersecting Cone and Square Prism.
78— IXA—Lettering—Form and Spacing.
79— IXB—Alphabets.
80— XA—Ink Bottle Stand.
81— XB—Bracket Shelf.
82— XC—Towel Roller.
83— XD—Book Support.
84 - XE—Leather Top Stool.
85— XIA—Isometric Cube and Circle.
86 - XIB—Isometric Cylinder and Prism.
87 - XIC—Mortise-and-Tenon Joint.
88— XID—Selected Problems in Isometric Projection.

NOTES ON THE PROBLEMS

Classification of Problems.

The problems in this book are arranged in groups, each successive group being intended to teach certain new facts or principles and to mark a new stage in the development of technique.

It is not intended that any individual student shall work all the problems in each group; often two or three are sufficient. The teacher, however, is the only person who can determine, in each individual case, just which problems must be worked out.

The teacher will not expect every pupil of a given class to have acquired the same degree of skill at the end of each group, but he will expect each pupil to have gained enough power to enable him to take up successfully the problems of the next succeeding group. The stronger pupils will work more problems than is necessary to satisfy the minimum requirement and so approach the next group with a wider knowledge and greater skill. It is believed that the number and variety of problems will be found sufficient to meet the needs, even in a class where there is great diversity of natural ability and previous experience.

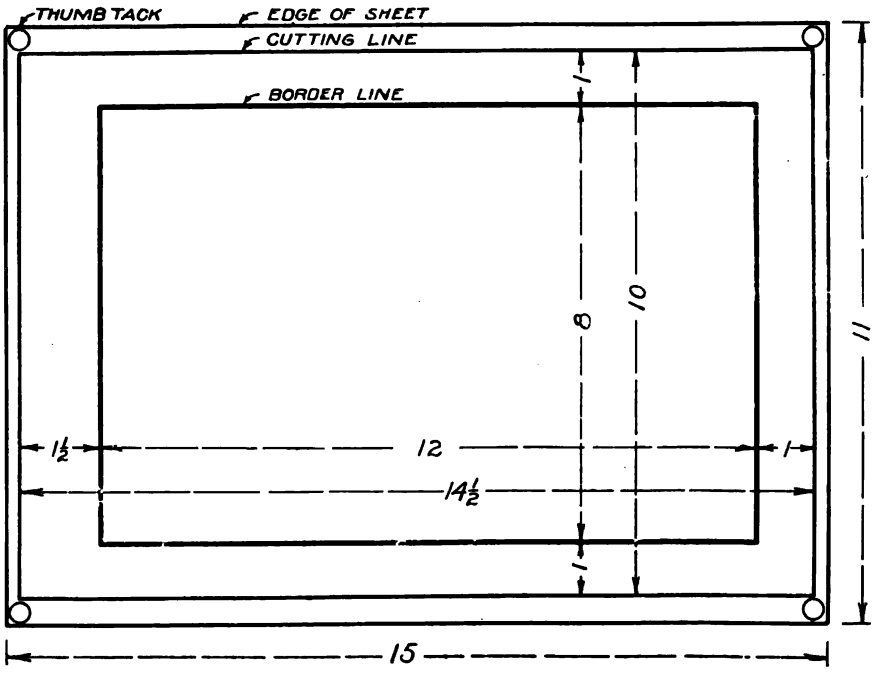

THUMB TACK
EDGE OF SHEET
CUTTING LINE
BORDER LINE
1
8
10
11
1½
12
1
14½
1
15

Fig. 1

The Lay-Out of the Sheet.

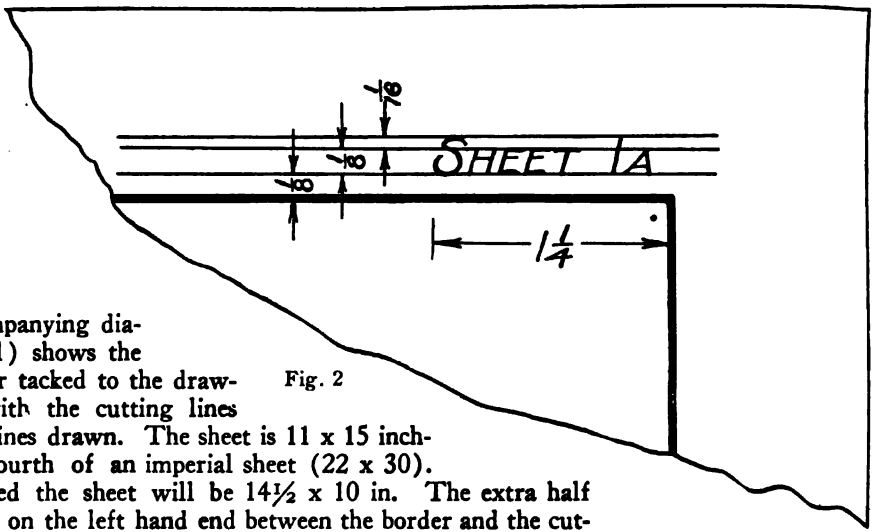


Fig. 2

The accompanying diagram (Fig. 1) shows the sheet of paper tacked to the drawing board with the cutting lines and border lines drawn. The sheet is 11 x 15 inches, or one-fourth of an imperial sheet (22 x 30). When finished the sheet will be 14½ x 10 in. The extra half inch of space on the left hand end between the border and the cutting lines is provided so that each pupil may bind together the drawings of the course. This may be done by punching two or more holes and tying the sheets together with a cord through these holes.

Fig. 2 shows the method of laying out the sheet number at the right-hand upper corner.

Kinds of Lines.

The most important kinds of lines used in mechanical drawing are shown below:

1. *Light line*—For penciling and cross hatching.
2. *Full line*—For visible outlines of objects and limits of parts.
3. *Heavy line*—For border lines.
4. *Dot line*—For invisible outlines of objects and limits of invisible parts. Same width as 2.
5. *Dash line*—For projection lines. Same width as 1.
6. *Long dash line*—For dimension lines. Same width as 1.
7. *Dot-and-dash line*—For center lines and section lines. Same width as 1.

Fig. 3

Group I.—Straight Lines.

The problems of this group have been selected to teach the first use of the scale, pencil, tee-square and triangles, and, if a part or all of the sheets are inked in, the use of the ruling pen. It is desirable that the problems in this group be first worked out freehand, putting on the dimensions as indicated on the plates. Each freehand drawing shall be followed by a mechanical drawing of the same object.

The small perspective sketch at the right-hand upper corner of each plate in this group is given to make clear the shape of the object. In working out the problem the perspective sketch is of course omitted and the drawing placed central on the sheet. The dimensions should also be omitted so that the finished drawing will appear as in the plate marked "Sheet Ia," Plate 3.

It is of greatest importance that the pupil realize from the very beginning that he is to work to cross lines, not from point to point. The penciling should therefore be done with *fine lines* of *indefinite length* as shown in Plate 2. The method of procedure is as follows:

1. Lay out the border and cutting lines as shown in Fig. 1.

2. Determine the location of the several views on the sheet—just how much space between views and between border lines and views. It is usually better to make the space between views less than between the border line and a view. See Plate 3.

3. Placing the scale vertically on the sheet, make light marks locating the most important horizontal lines, as top and bottom lines of views.

4. Draw long indefinite horizontal lines through the marks thus made.

5. Placing the scale horizontally on the sheet measure for important vertical lines.

6. Draw indefinite vertical lines through these marks and crossing the horizontal lines.

7. Complete the view which tells most about the object. In problems IA, IB, and IC this is the front view, in IE it is the end view, in IF it is the top view.

8. Projecting as much as possible from the view just drawn, thus avoiding much measuring, complete the other views. The drawing now appears as in Plate 2 or Plate 5 as the case may be.

9. Ink in (a) horizontal full lines and dot lines; that is, the horizontal lines that represent visible and invisible outlines of the object; (b) vertical full lines and dot lines; (c) inclined full lines and dot lines. This includes all lines of the width of line 2, Fig. 3.

10. Ink in dash lines; that is, the projection lines connecting the views at their extreme limits. These should be light lines. See line 5, Fig. 3.

11. Ink in the border line with heavy lines. See line 3, Fig. 3.

12. Ink in the sheet number, as in Plate 3.

13. Trim the sheet to the cutting lines.

In case the sheet is not inked, the same order as is given for inking should be followed in going over the important lines with heavier pencil lines.

The rectangular frame, IA, the try-square, IC, and the box, IF and IG, give practice in horizontal and vertical lines only while the triangular frame, IB, and the dovetail ways, IE, require lines to be drawn at an angle of 60°. Each involves the representation of invisible edges. It will be noticed that in the rectangular frame the

three views—top, front and side—are all given; in the triangular frame, the try-square, the shelf, the dovetail ways and the box, IF, two views are given and the pupil is required to find the third. In the box, IG, and problem IJ, he is required to find all three. In every case the top view should be placed above the front view, and the right-hand view at the right of the front view. If the left-hand view were to be shown as it might be in problems IG or IJ, it should be placed at the left of the front view.

GROUP II.—CIRCLES.

In this group we learn the correct use of the compass in drawing circles, the use of center lines, and the use of sections and how to represent them by cross-hatching.

On account of the circles a new method of procedure is necessary:

1. After the border and cutting lines of the sheet have been laid out locate and draw the center lines. In penciling, these are like all other straight lines, very light and of indefinite length.
2. Draw the circles.
3. Draw the other views, ***projecting from the circles*** as much as possible to insure accuracy and to save making measurements. Complete the penciling.
4. Ink in all the circles. These will be with the full line or with the dotted line.
5. Ink in (a) horizontal full lines and dot lines; (b) vertical full lines and dot lines; (c) inclined full lines and dot lines.
6. Ink in projection (or dash) lines and the center (or dot-and-dash) lines. Remember that these are always light lines.
7. Ink in border lines.
8. Ink in sheet number.
9. Trim the sheet to the cutting lines.

Group III.—Tangents.

The problems in this group give practice in drawing straight lines tangent to circles, and circles tangent to each other. This involves finding the centers of circles and the points of tangency.

In the face-plate problems, IIIB and IIIC, the method of finding the center of the half-inch arc is indicated in the diagram at the left-hand upper corner of each sheet, the figures indicating the order in placing the center point of the compass in constructing the arc. In the crank, IIID, and the gland, IIIE, the dotted lines perpendicular to the straight sides of the figure indicate the points of tangency. All the points of tangency should thus be accurately determined in the pencil drawing but the lines used in finding them should not be inked in. It is almost impossible to do successful inking if these points of tangency have not been found. In the link, IIIG, the dotted lines suggest the method of determining the points of tangency.

Group IV.—Planes of Projection.

Before the work of this group is begun the teacher will doubtless give a full explanation of the meaning of planes of projection and so all that is needed here is to make clear what is represented in problem IVA. Figure 4 represents a block of wood, or we may imagine that it is one section of a building with a saw-tooth roof or that it is an artist's studio.

In the problems of the previous groups we have learned to make top, front and side or end views of objects, but we have not learned anything about the theory which explains the relation of one view to the other. Briefly it is this: We suppose

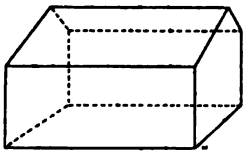


Fig. 4

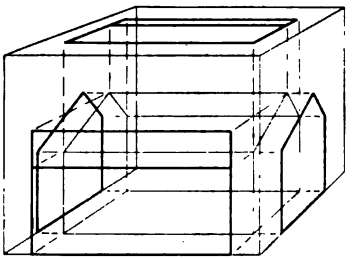


Fig. 5

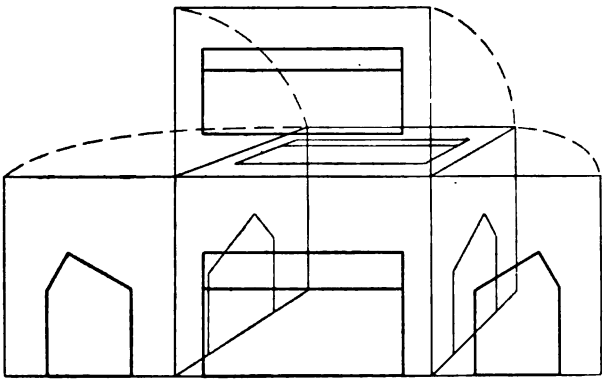


Fig. 6

the object we are drawing to be surrounded by transparent planes, as though in a box with glass sides; then on as many sides as we wish views, we project perpendicularly through the glass to the object point by point and line by line, drawing the required views on the corresponding planes. See Fig. 5. Finally the planes upon which the projections have been made are revolved into one plane, Fig. 6, which is the plane of the front view.

In Plate 28 the dot-and-dash lines represent the intersection lines of the planes of projection and the arcs of circles in dash lines indicate the revolution of the planes. Plate 28 also shows how a side or end view may be revolved in two different ways. The left end view is shown upright opposite the front view or on its side, as it were, opposite the top view.

When this explanation of the relation of views is understood it becomes perfectly clear why the right end view, Plate 28, is turned just the opposite way from the left end view.

In working out this problem draw the plane lines first, then the right-hand end. From this view project to the others.

The figures in the right-hand upper corners of most of the plates in this group are of special importance because they indicate the draughtsman's method of constructing several of the most common geometric figures.

Group V.—Revolution of Solids.

In this group is given further practice in projection, in order to develop the power to see an object in any position and its changes in revolving from one position to another. In some of the problems the planes of pro-

jection are suggested; in others they are not. In VF and VG, for example, the points in the required views may be found by revolution from the given views, while in VH and VJ they must be found in part by transference.

GROUP VI.—DEVELOPMENT OF PRISMS AND PYRAMIDS.

While the last group gave practice in revolving solids, this group emphasizes the revolution of surfaces. Lines are also revolved to find their true length.

GROUP VII.—DEVELOPMENT OF CYLINDERS AND CONES.

The method of working in this group is suggested by Plates 61 and 63. Plate 63, which gives the solution of problem VIIB, suggests the method by projection which is desirable but not always possible or convenient. Plate 61 suggests the usual method which is by picking up distances and laying them off on a center line.

GROUP VIII.—INTERSECTIONS.

The problems of this group follow very naturally after the problems of the two previous groups and give practice in drawing curves of intersection.

GROUP IX.—LETTERING.

Special attention is given to making letters and figures at this point in the course in order to prepare for the group of working drawings which immediately follows. Students may profitably work out Plate 78,

enlarging it to twice its present size, but it is not expected that Plate 79 will be treated in this way. Instead, the student may work out a text or title page or both, consulting Plate 79 for the forms of letters and figures. Plate 78 gives the form and proportions of very simple letters and these should be studied carefully. The last line of letters on this plate ilustrates bad and good spacing. The fact is made clear that the space allowed between letters must depend upon the shape of the letters that stand side by side, and not upon a fixed distance common to all letters.

Group X.—Working Drawings.

The drawing of the ink bottle stand, problem XA, illustrates the proper placing of dimensions when a series of holes appears in a working drawing. The bracket-shelf, problem XB, shows how to place dimensions on arcs of circles. The towel roller, problem XC, is an example of a broken piece, yet with full length dimensions given. The book-support, problem XD, shows how to place dimensions on a freehand curve, and the leather-top stool, problem XE, is one of the many problems in constructive design which finds a place in the course at this point; especially if the student is pursuing a course in shopwork parallel to his drawing course.

Group XI.—Isometric Drawings.

Plates 85, 86 and 87 give enough problems to illustrate the principle of isometric drawing. Plate 88 suggests further applications of the principle.

RECTANGULAR FRAME

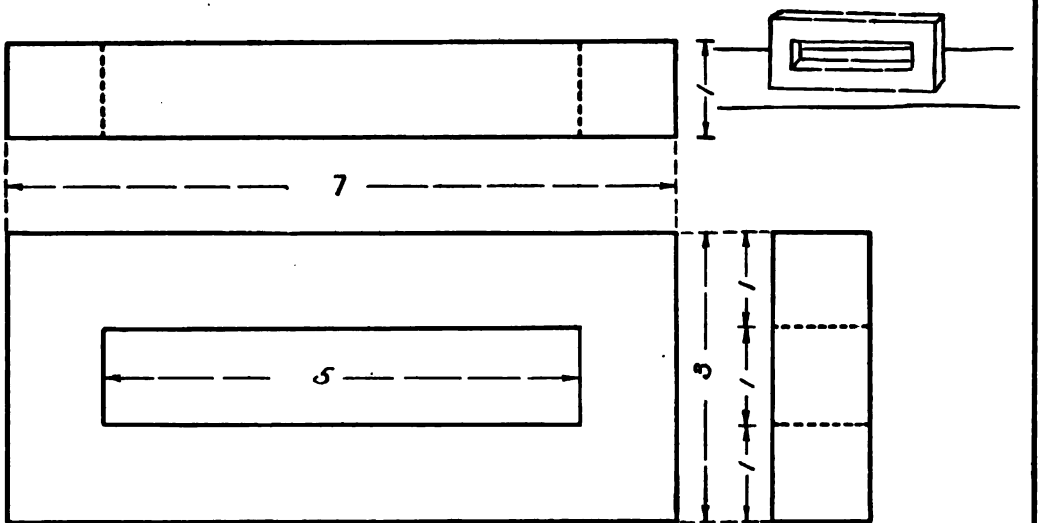


PLATE 1

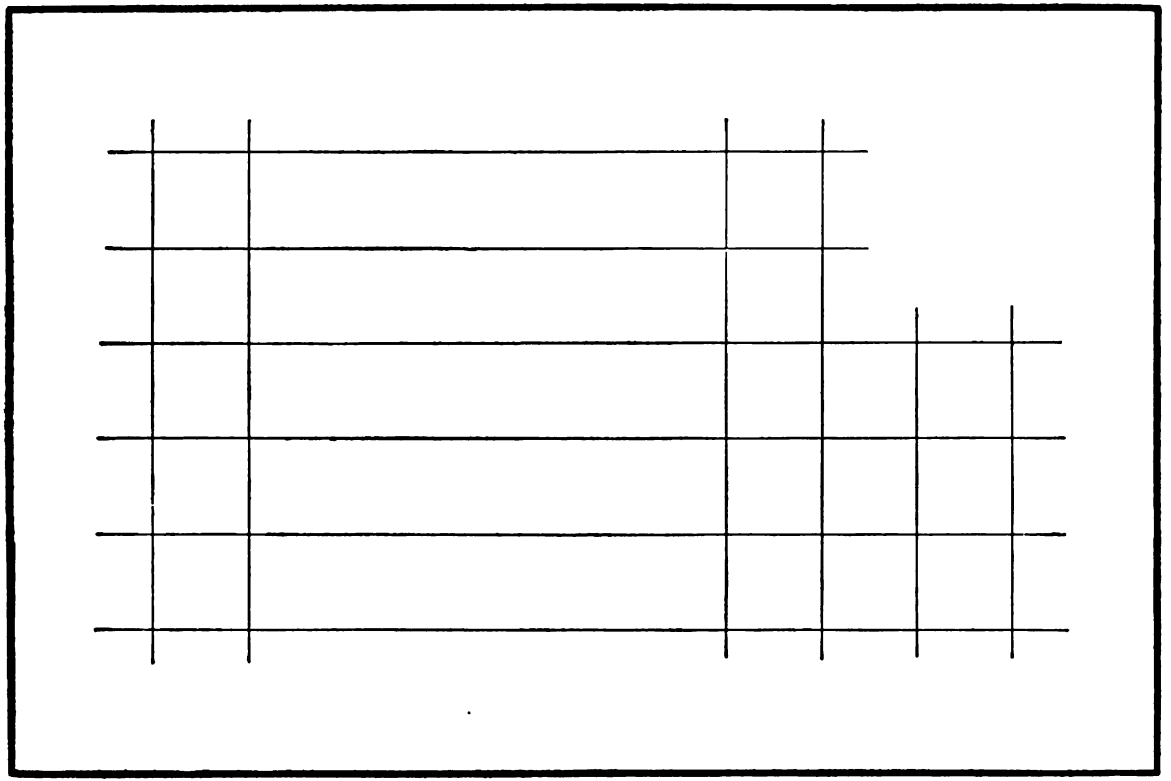


PLATE 2

SHEET 1A

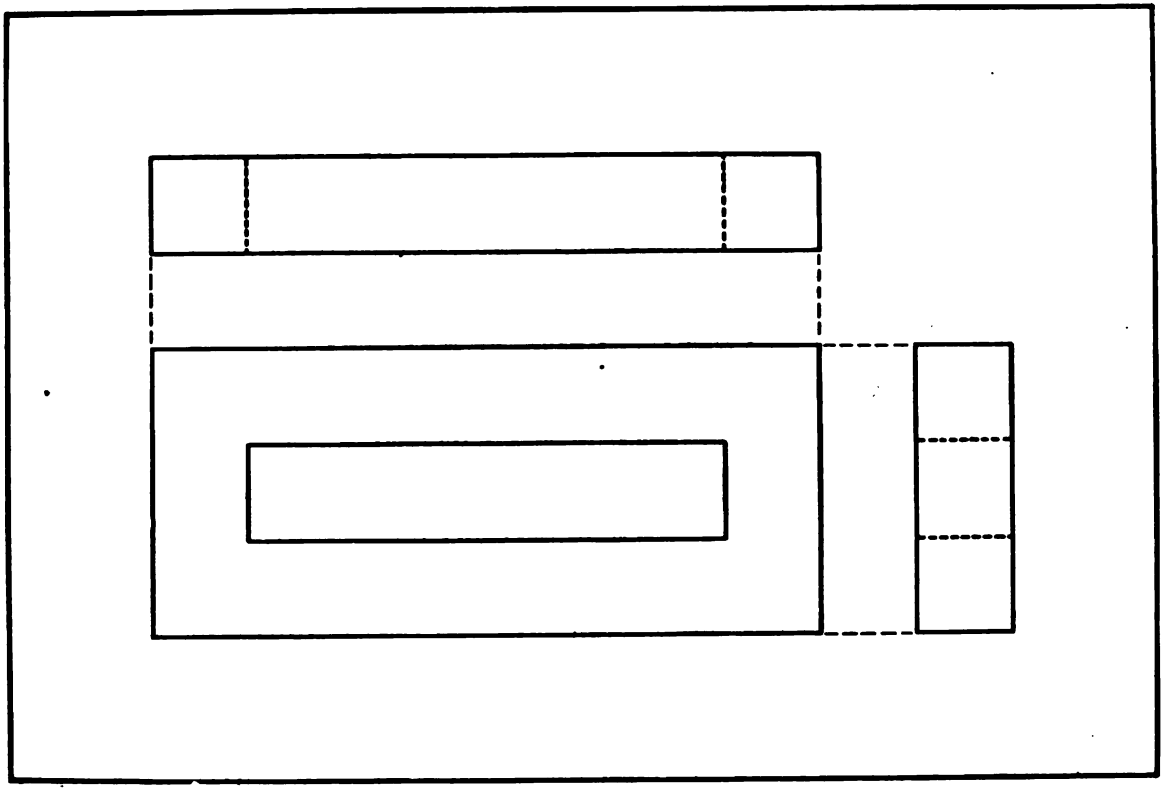


PLATE 3

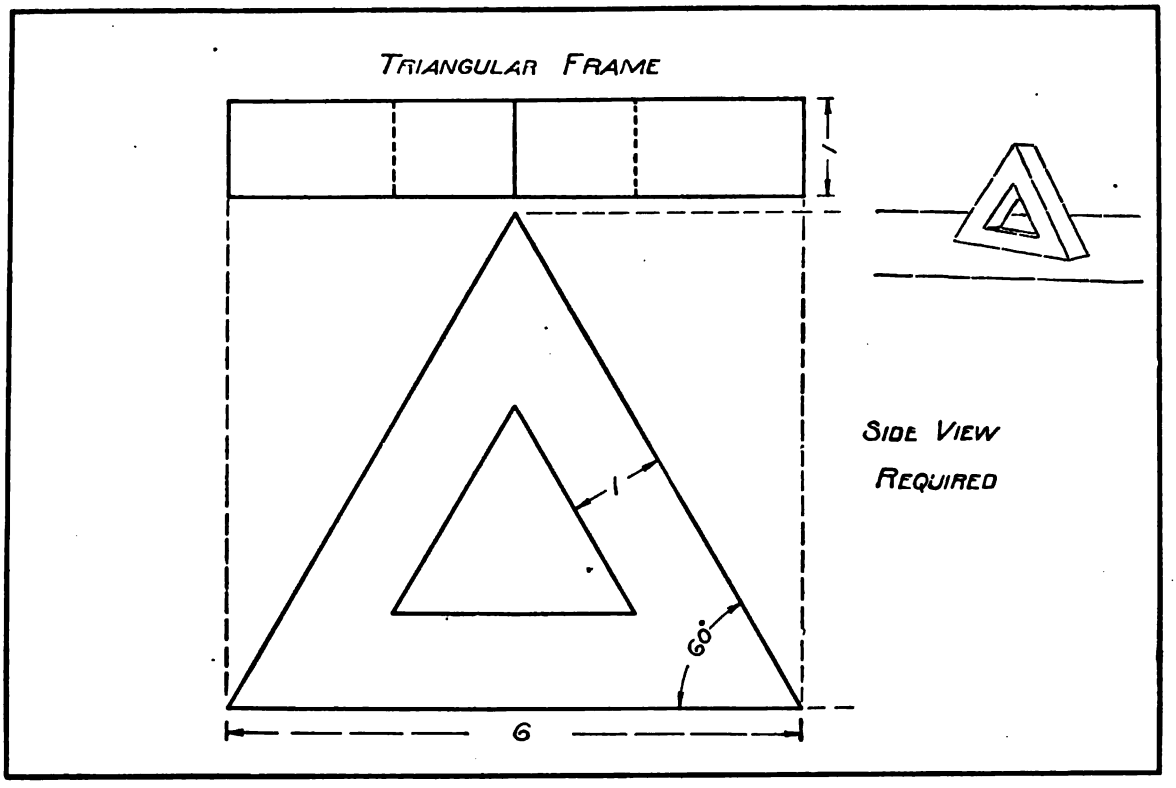


PLATE 4

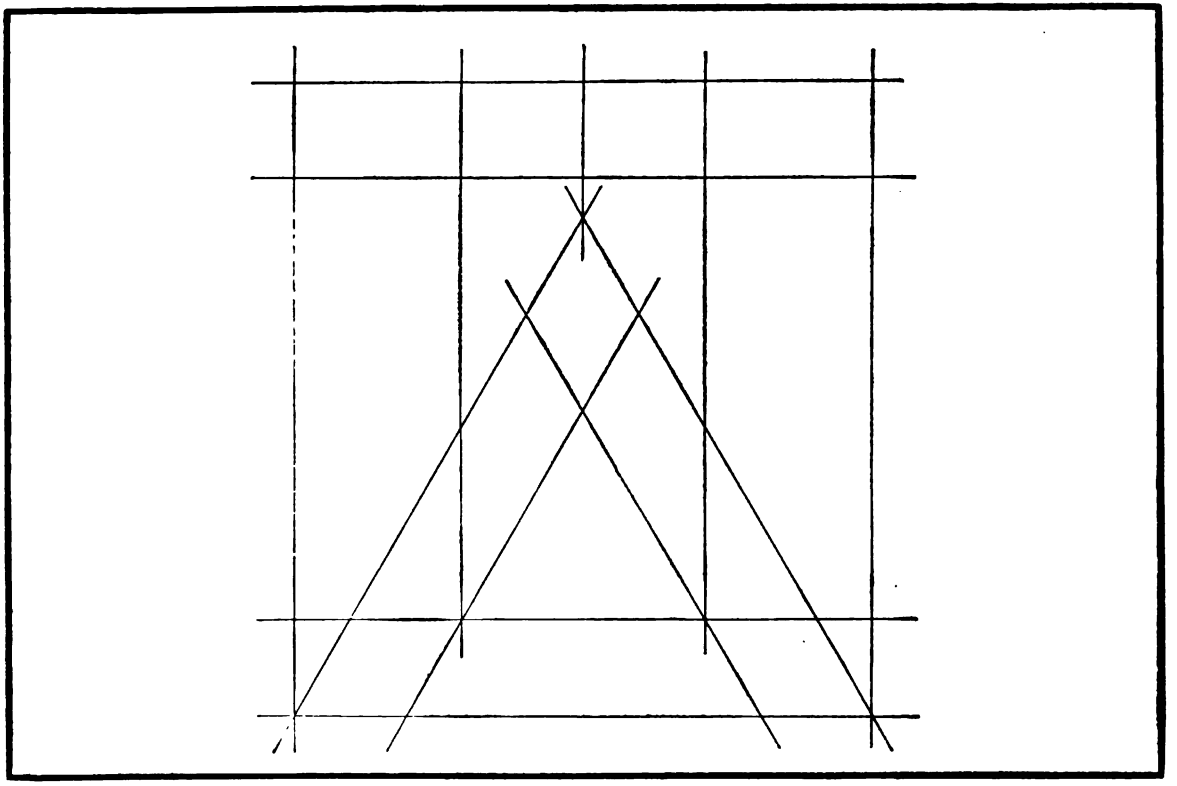


PLATE 5

TRY SQUARE

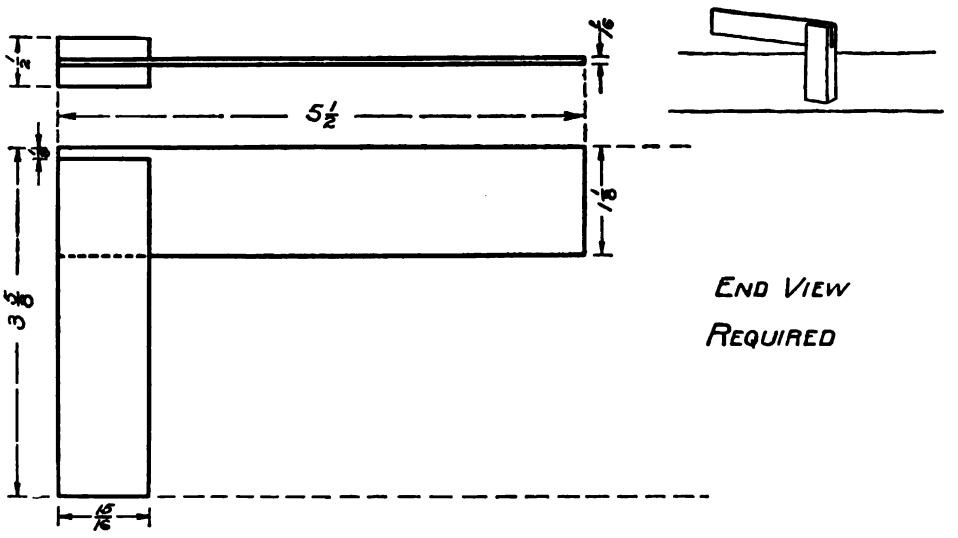


PLATE 6

SHELF

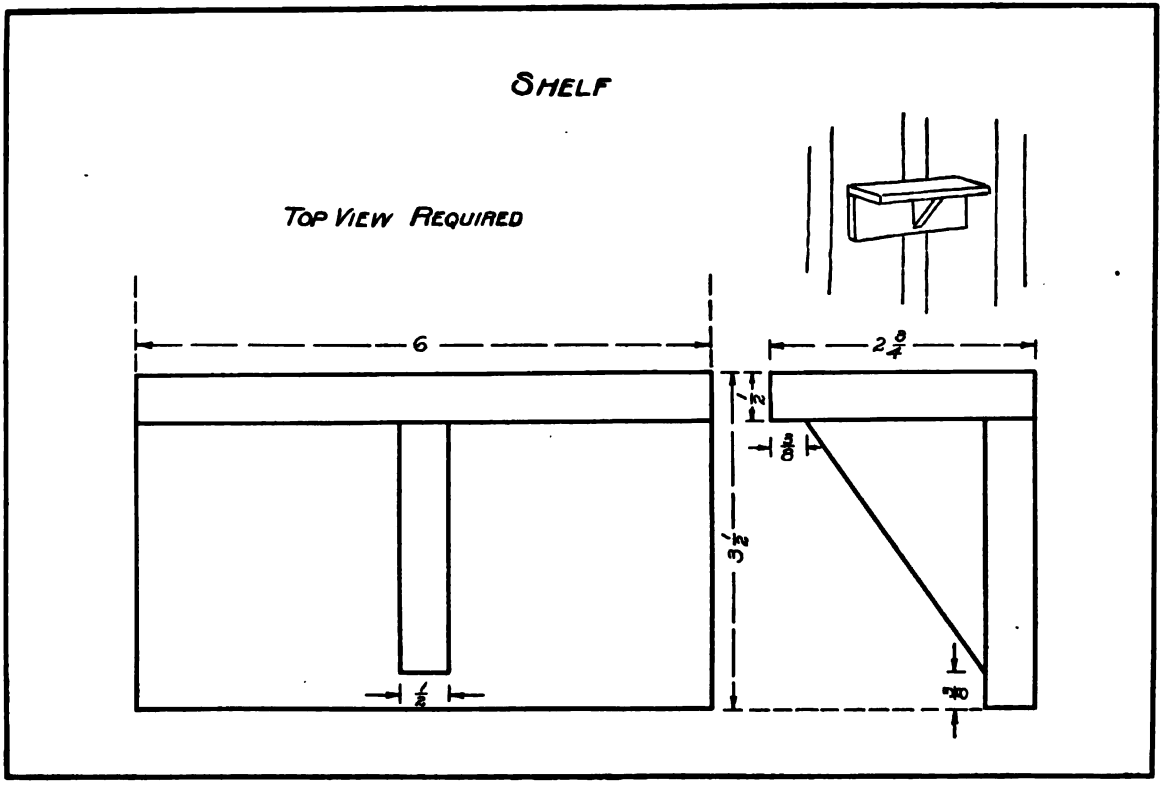
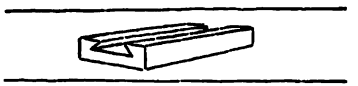


PLATE 7

DOVETAIL WAYS



TOP VIEW REQUIRED

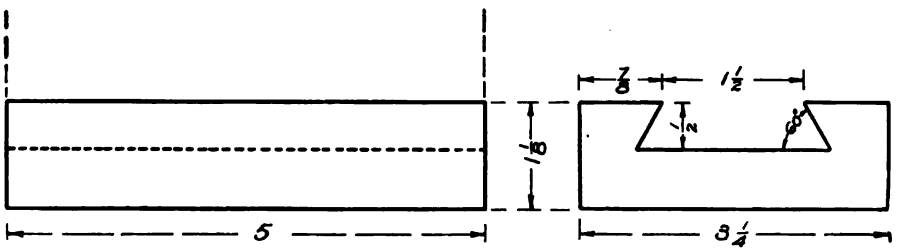
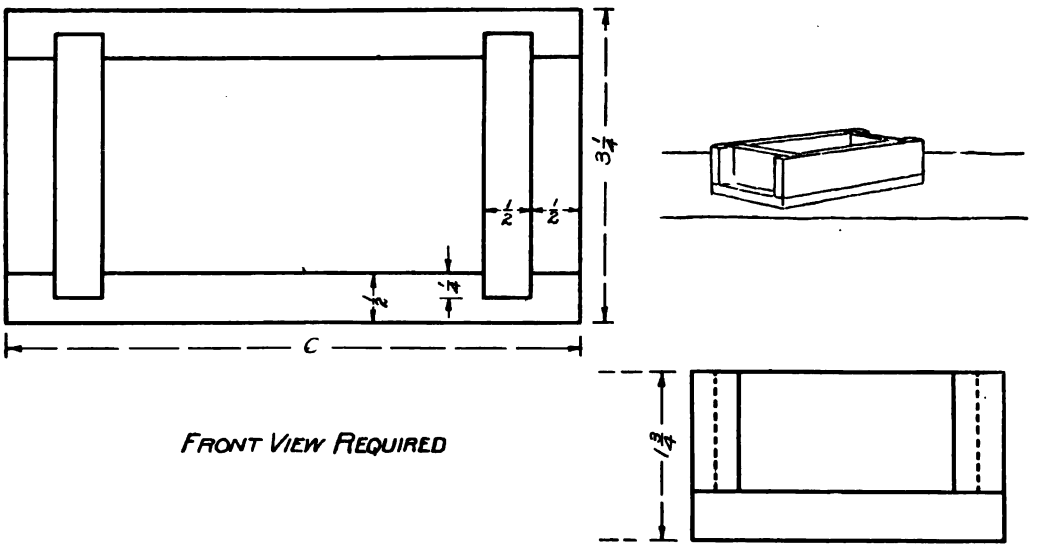


PLATE 8

Box



FRONT VIEW REQUIRED

PLATE 9

Box

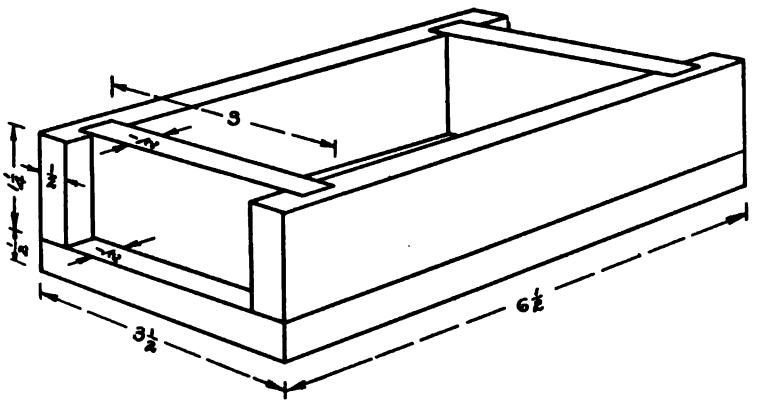
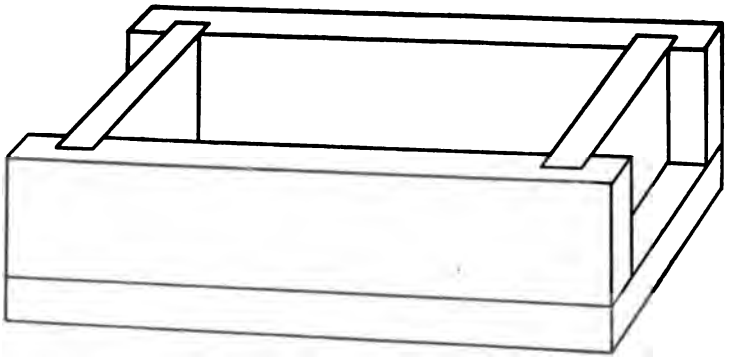


PLATE 10

Box



Outside Dimensions; $6\frac{1}{2} \times 3\frac{1}{2} \times 1\frac{3}{4}$
Thickness of Stock; $\frac{1}{2}$ in.

SELECT SOME OBJECT THAT CAN BE DRAWN WITH STRAIGHT LINES, SUCH AS A BENCH-HOOK, BOX, BREAD-BOARD, FLOWER-POT STAND, SQUARE PRISM, OR MORTISE-AND-TENON JOINT. BE SURE THAT IT IS NOT TOO LARGE TO BE DRAWN FULL SIZE ON THE SHEET. MAKE A FREEHAND WORKING SKETCH OF THE OBJECT PUTTING ON ALL THE DIMENSIONS NEEDED IN MAKING A MECHANICAL DRAWING FROM THE SKETCH. THEN MAKE A MECHANICAL DRAWING, SHOWING EITHER TWO OR THREE VIEWS OF THE OBJECT.

PLATE 12

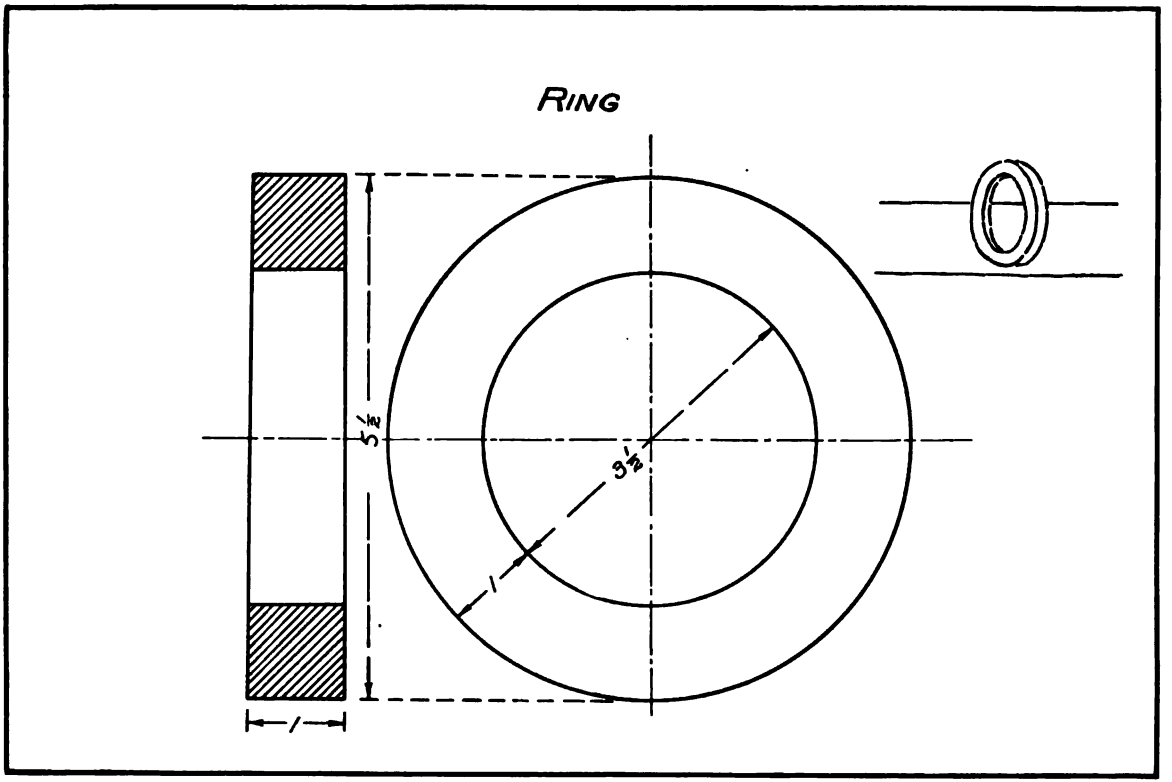


PLATE 13

PICTURE FRAME

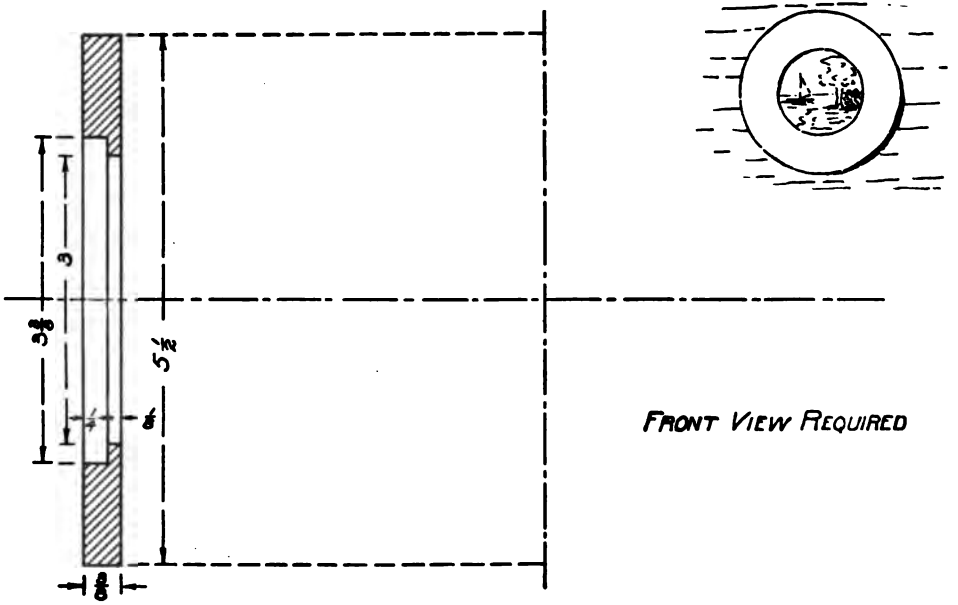


PLATE 14

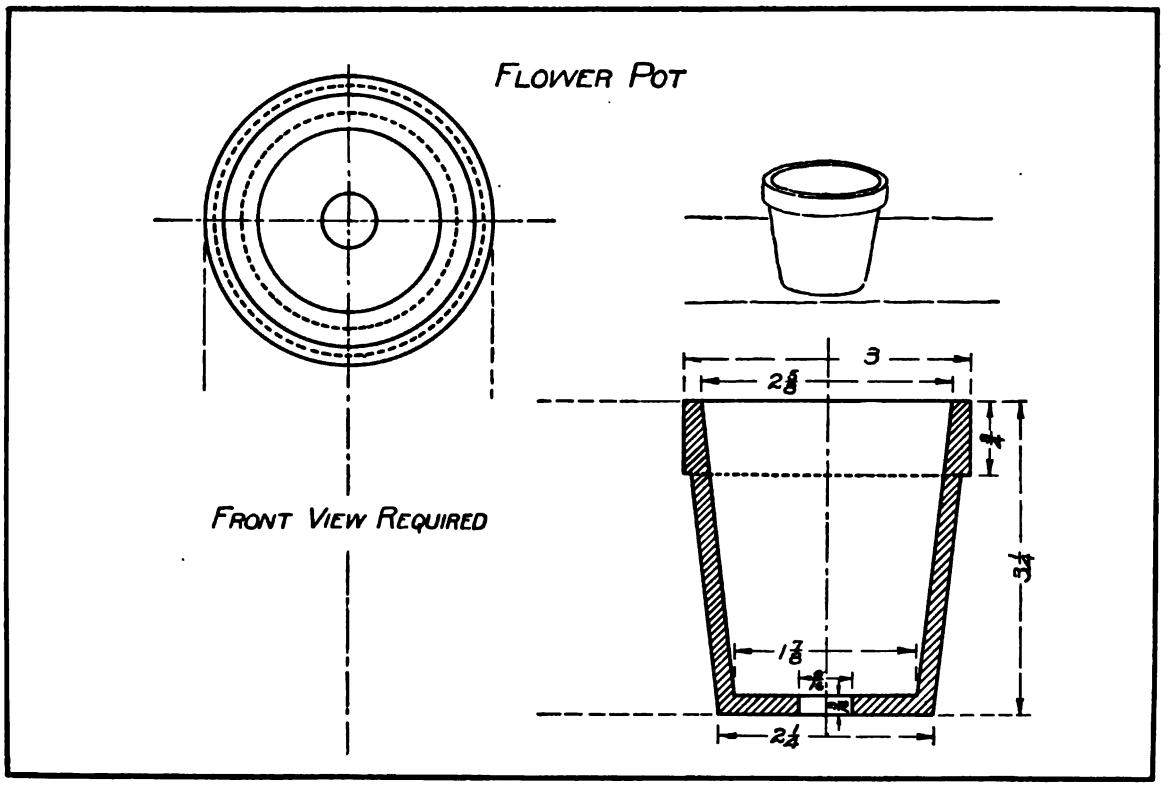


PLATE 15

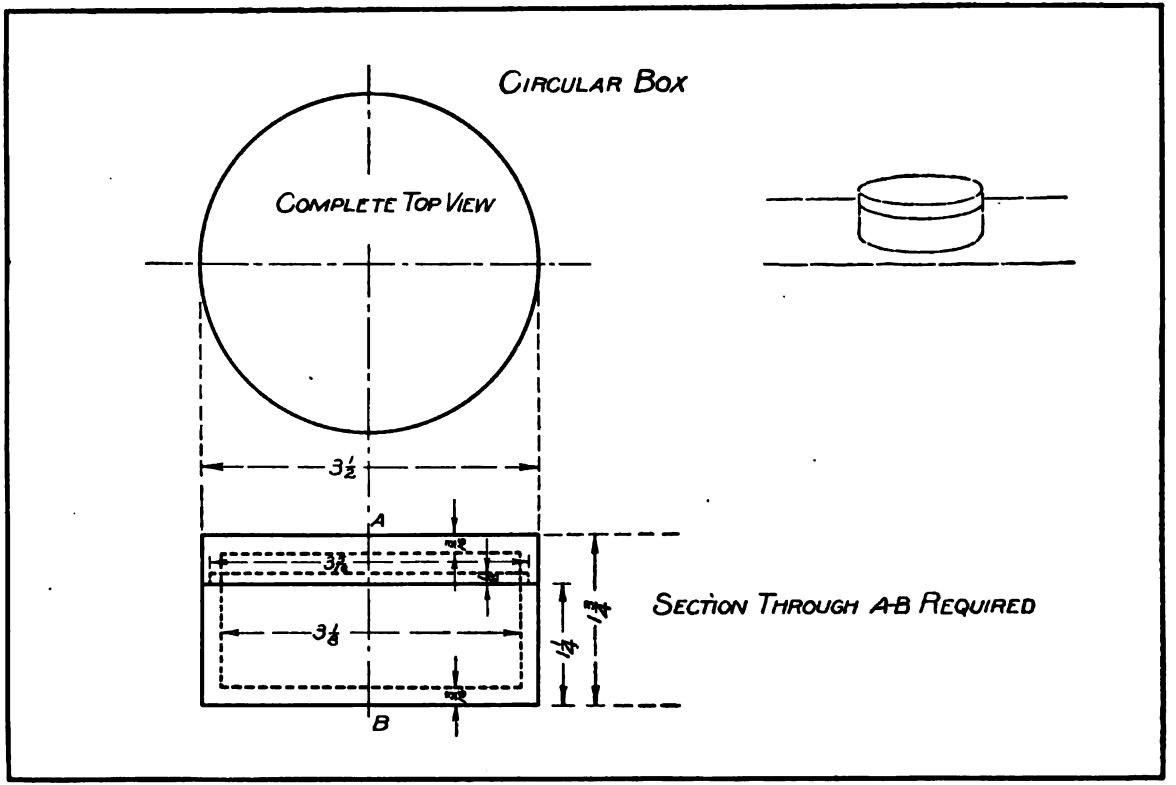
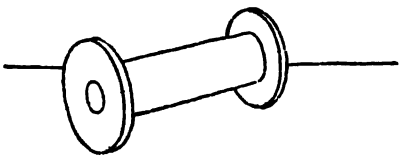

CIRCULAR BOX
COMPLETE TOP VIEW
3½
A
3⅜
3⅛
B
¼
1¼
SECTION THROUGH A-B REQUIRED

PLATE 16

SPOOL

SECTION THROUGH A-B REQUIRED



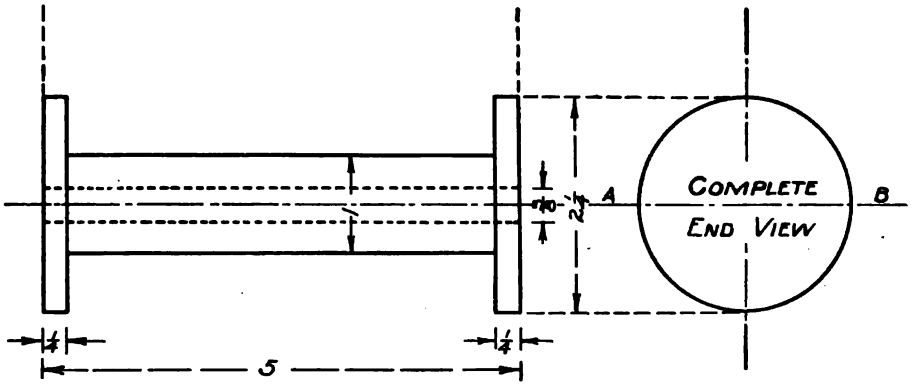


PLATE 17

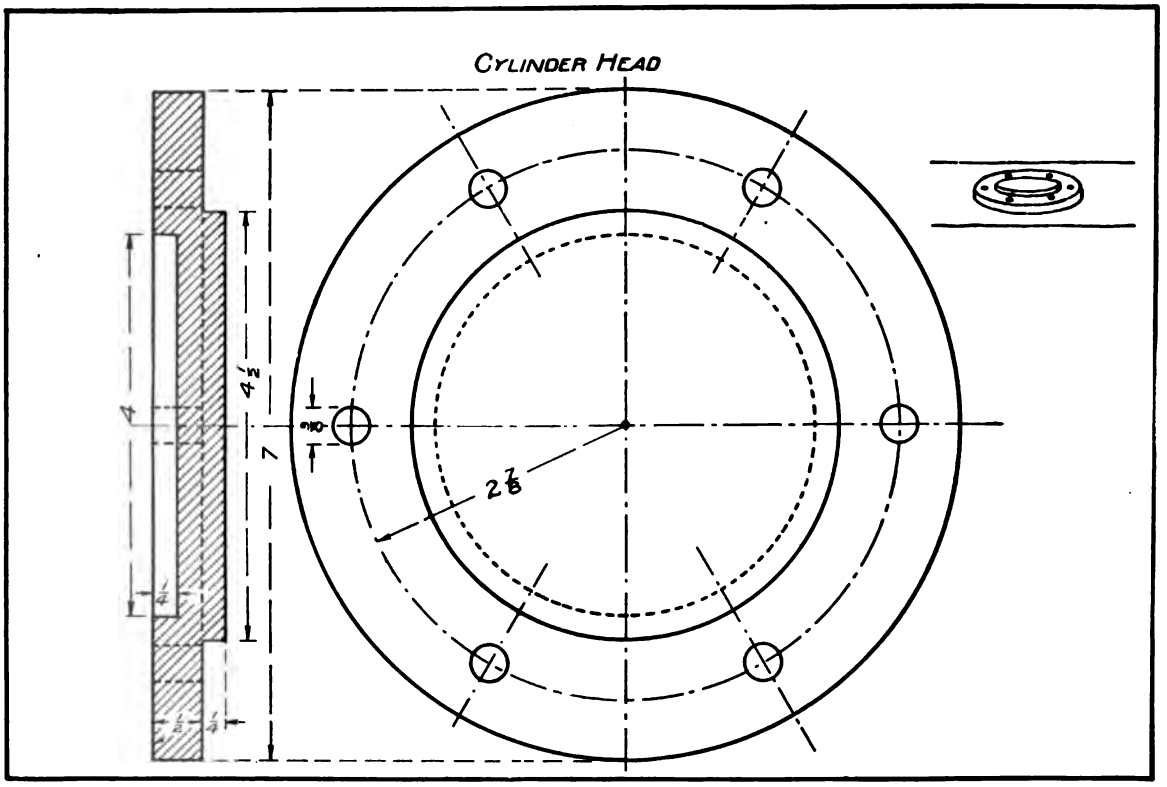


PLATE 18

SELECT SOME OBJECT THAT CAN BE DRAWN WITH CIRCLES AND STRAIGHT LINES, SUCH AS A TUMBLER, CONE, HOLLOW CYLINDER, LARGE BEVELED WASHER, EMERY WHEEL, ROLLER OR MALLET HEAD. BE SURE THAT IT IS NOT TOO LARGE TO BE DRAWN FULL SIZE ON THE SHEET. MAKE A FREEHAND WORKING SKETCH OF THE OBJECT, PUTTING ON ALL NEEDED DIMENSIONS. THEN MAKE A MECHANICAL DRAWING SHOWING TWO VIEWS OF THE OBJECT, ONE OF WHICH MAY BE A SECTIONAL VIEW, IF SUCH A VIEW WILL MAKE THE DRAWING CLEARER.

PLATE 19

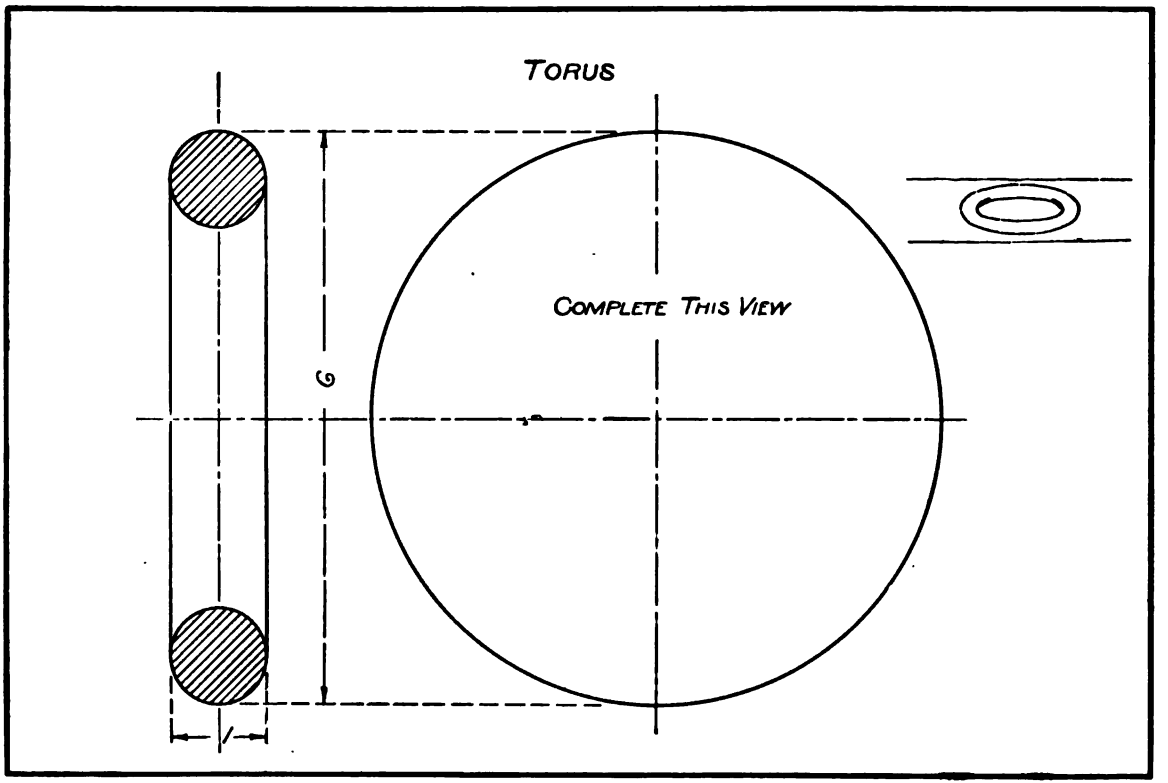


PLATE 20

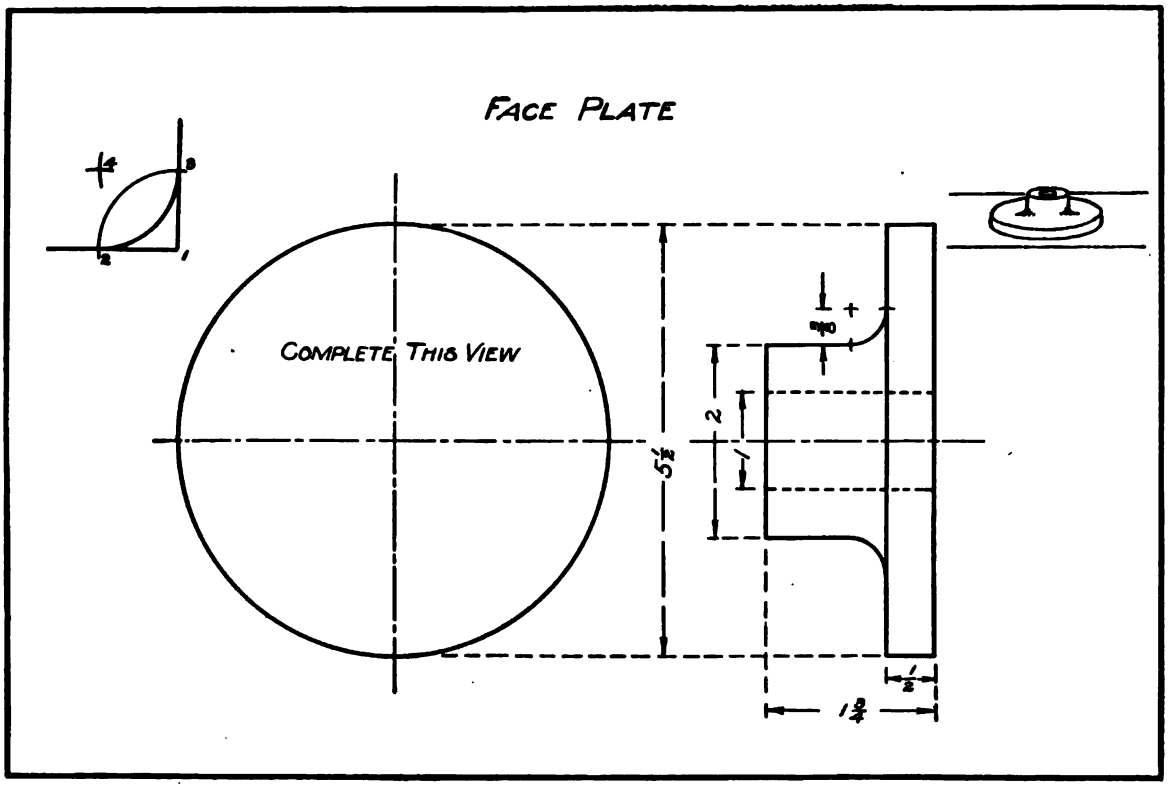


PLATE 21

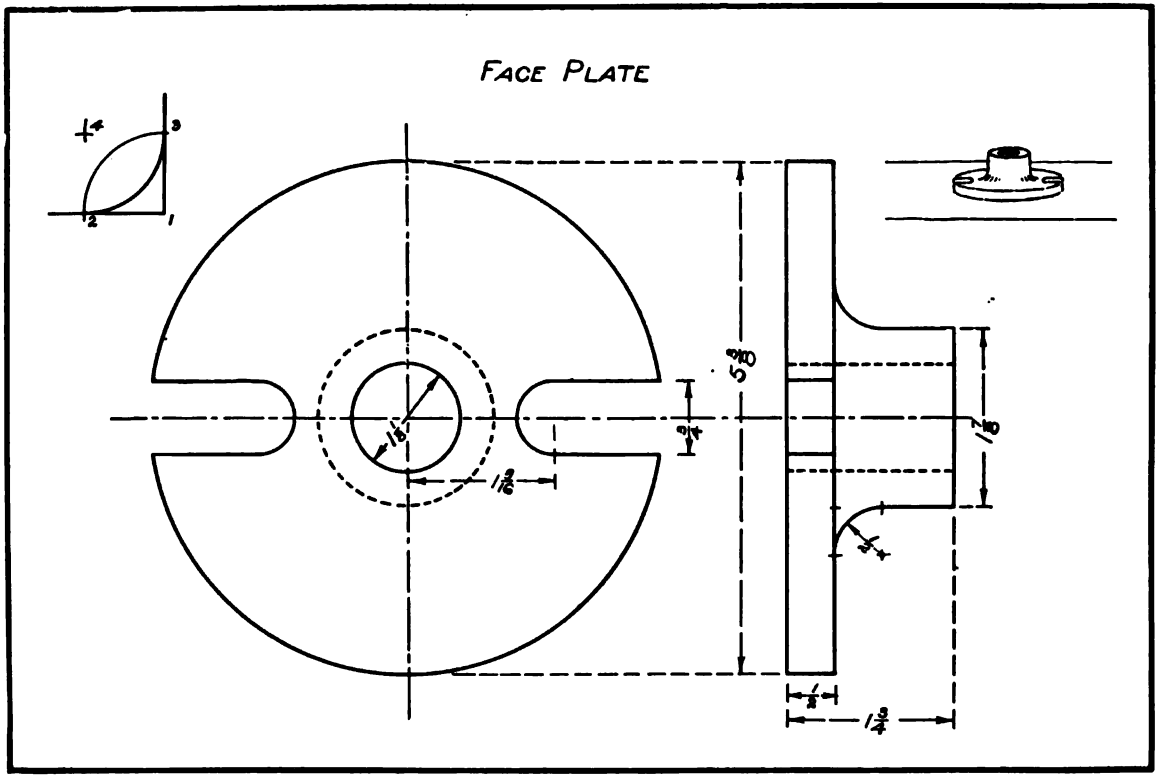


PLATE 22

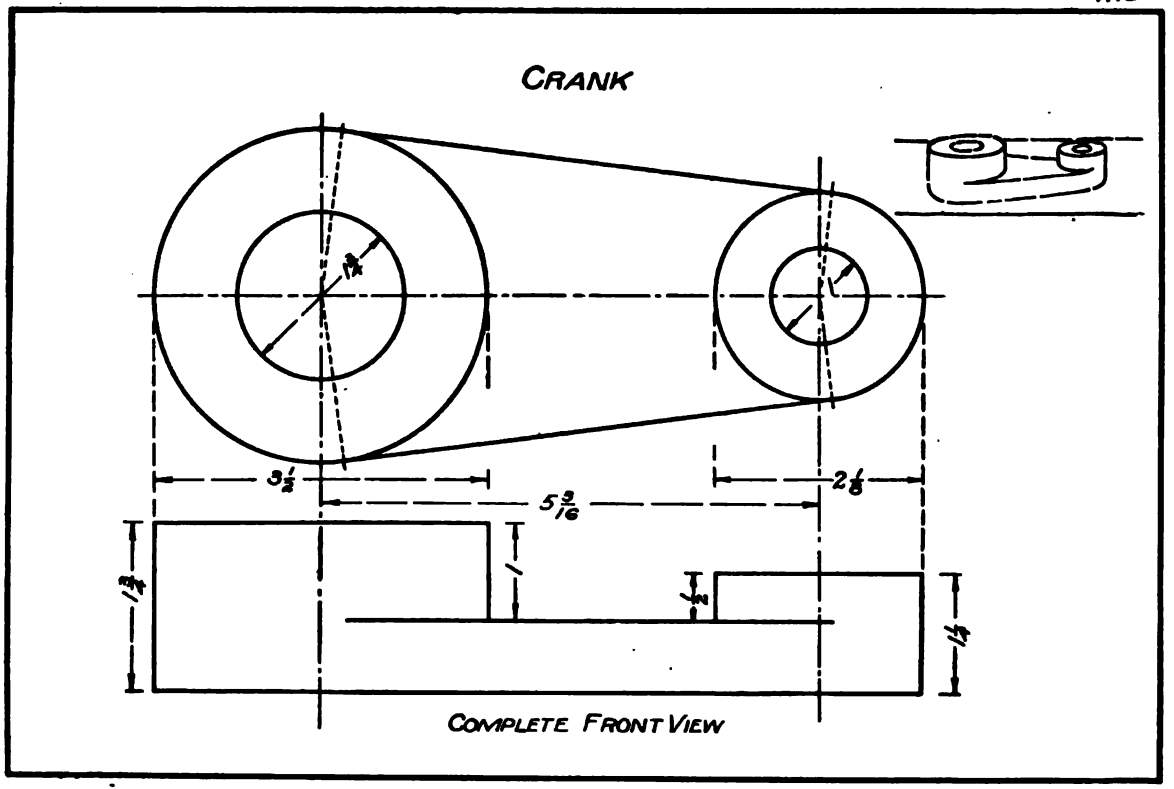


PLATE 23

GLAND

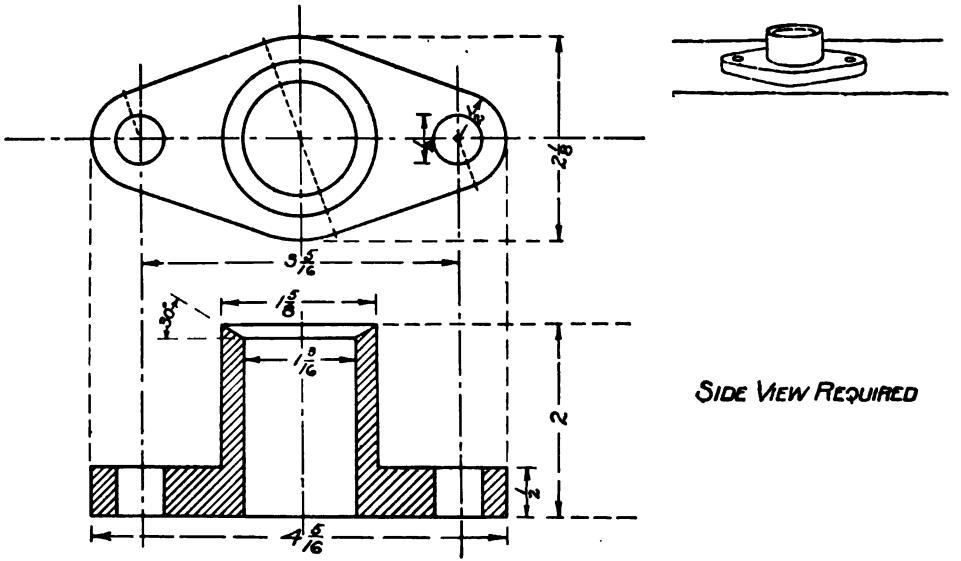


PLATE 24

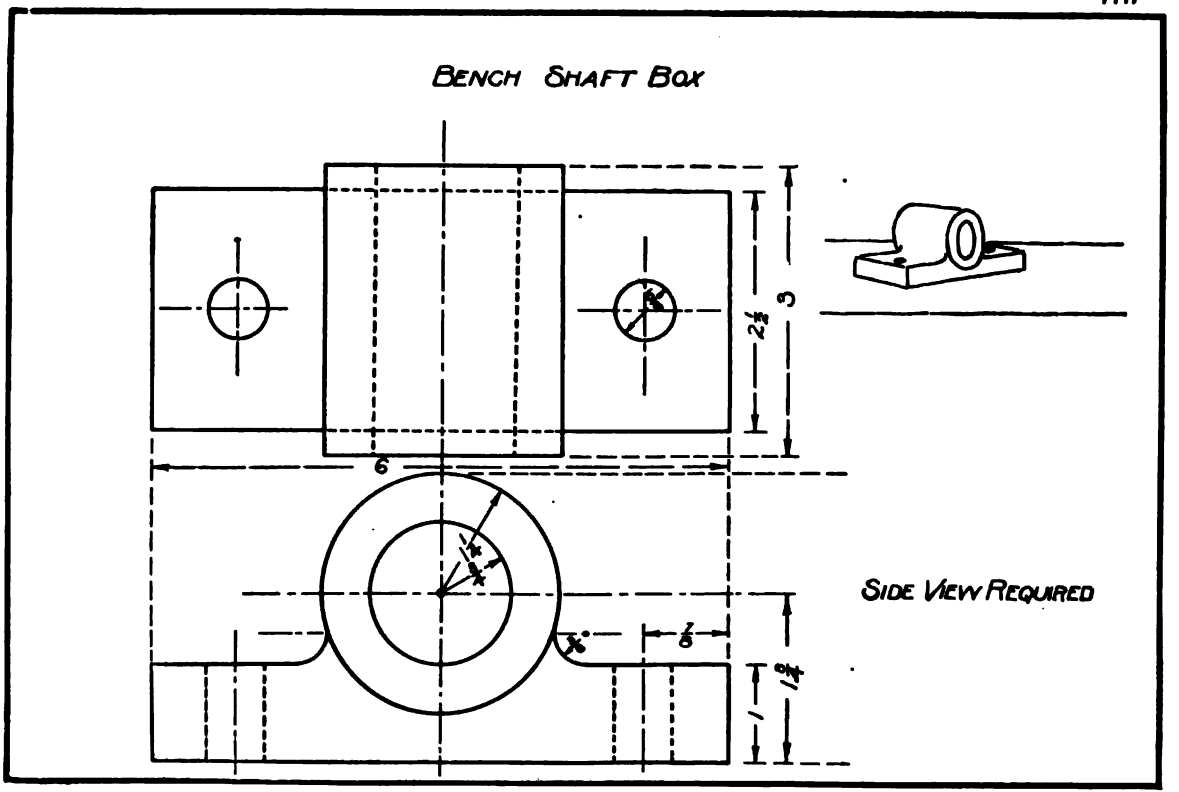


PLATE 25

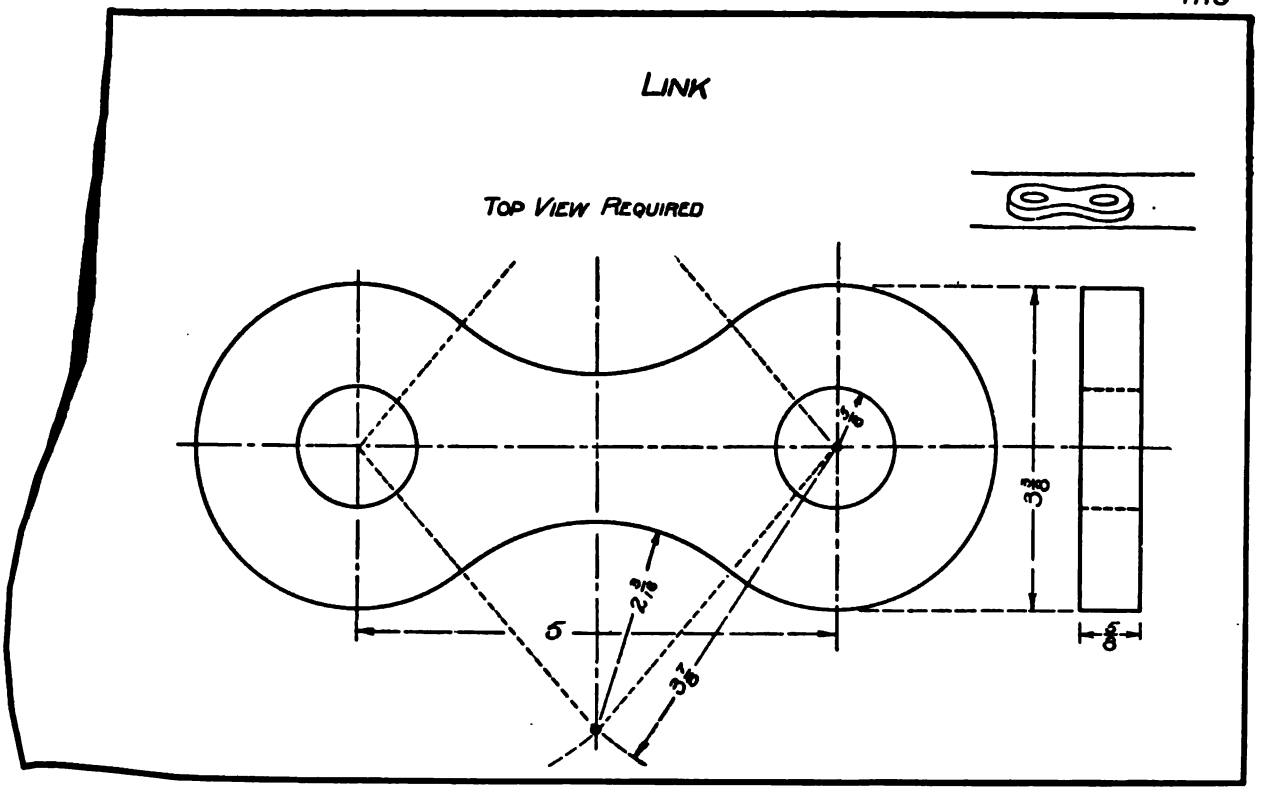


PLATE 26

SELECT SUCH AN OBJECT THAT THE DRAWING OF IT WILL REQUIRE THAT A STRAIGHT LINE BE DRAWN TANGENT TO A CIRCLE OR ARC OF A CIRCLE. MAKE A MECHANICAL DRAWING, TAKING MEASUREMENTS DIRECTLY FROM THE OBJECT. IF DESIRABLE THE DRAWING MAY BE MADE HALF THE SIZE OF THE OBJECT. MAKE AS MANY VIEWS AS ARE NEEDED TO COMPLETELY REPRESENT THE OBJECT. THE FOLLOWING ARE AMONG THE OBJECTS WHICH MAY BE SELECTED:— PEN-TRAY, BREAD-BOARD, LINK, ANGLE IRON, SMALL PULLEY, VALVE LEVER.

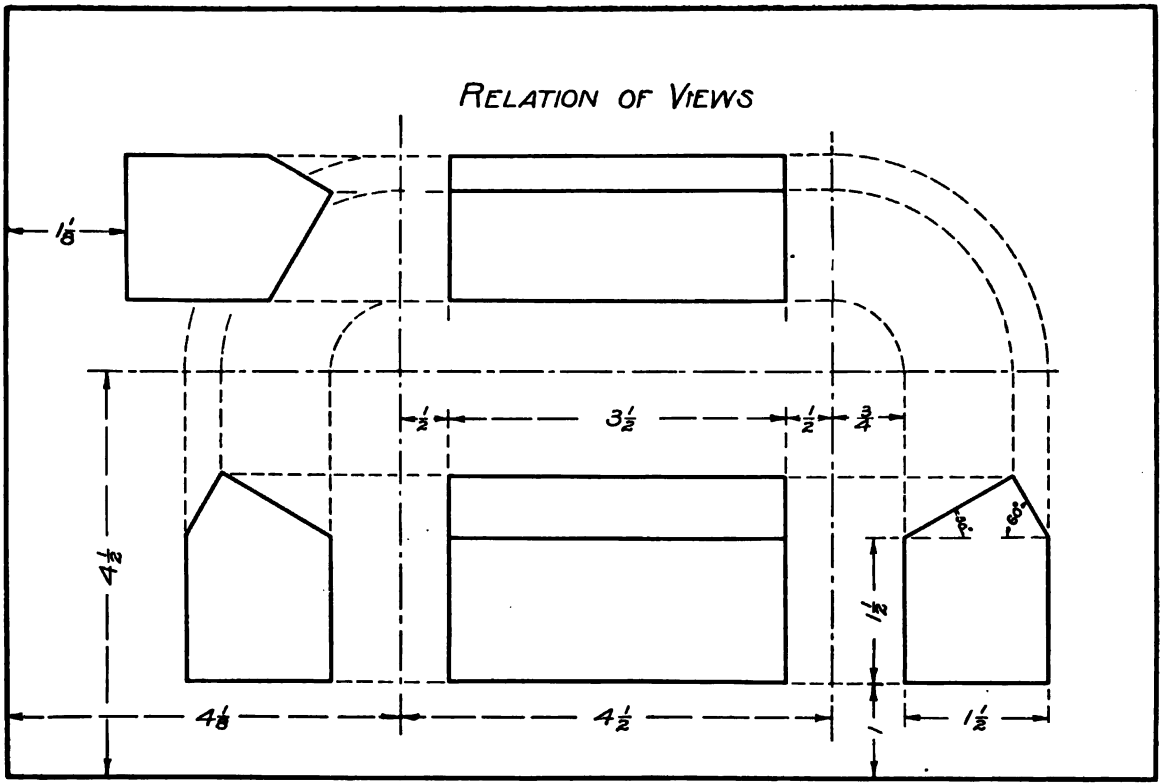


PLATE 28

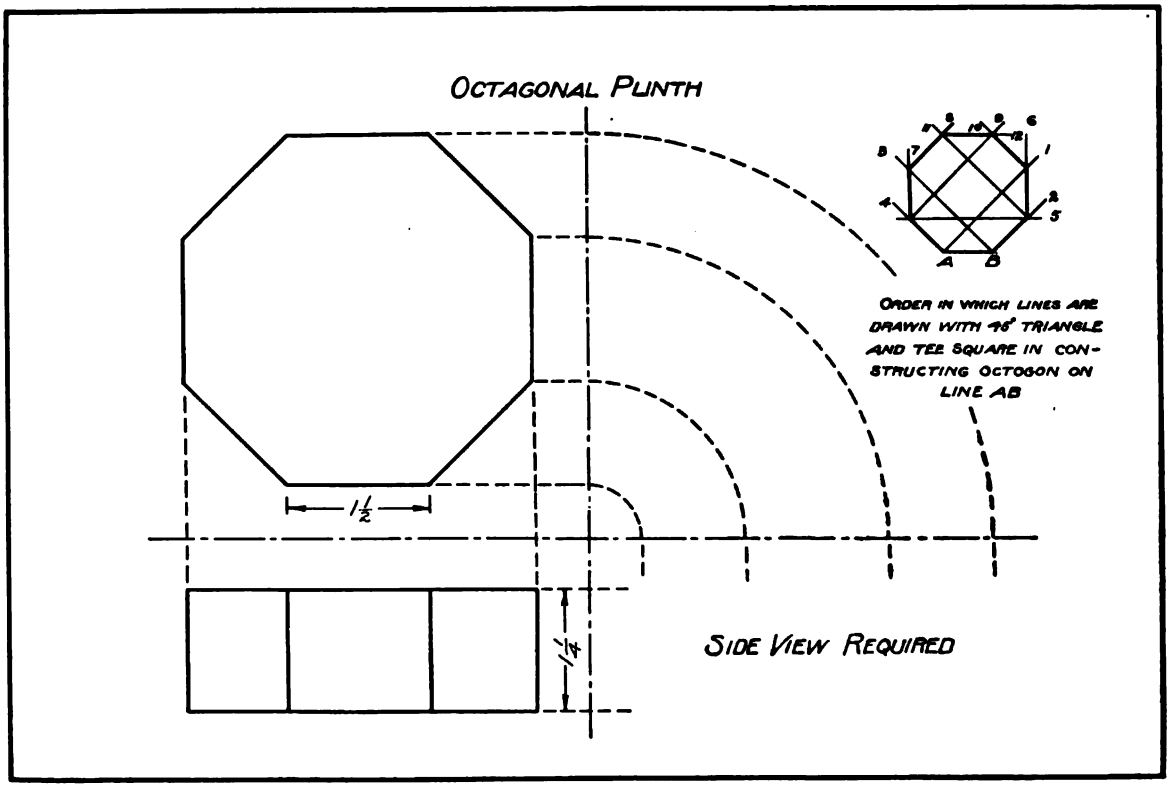

OCTAGONAL PLINTH
ORDER IN WHICH LINES ARE DRAWN WITH 45° TRIANGLE AND TEE SQUARE IN CONSTRUCTING OCTOGON ON LINE AB
1½
¼
SIDE VIEW REQUIRED

PLATE 29

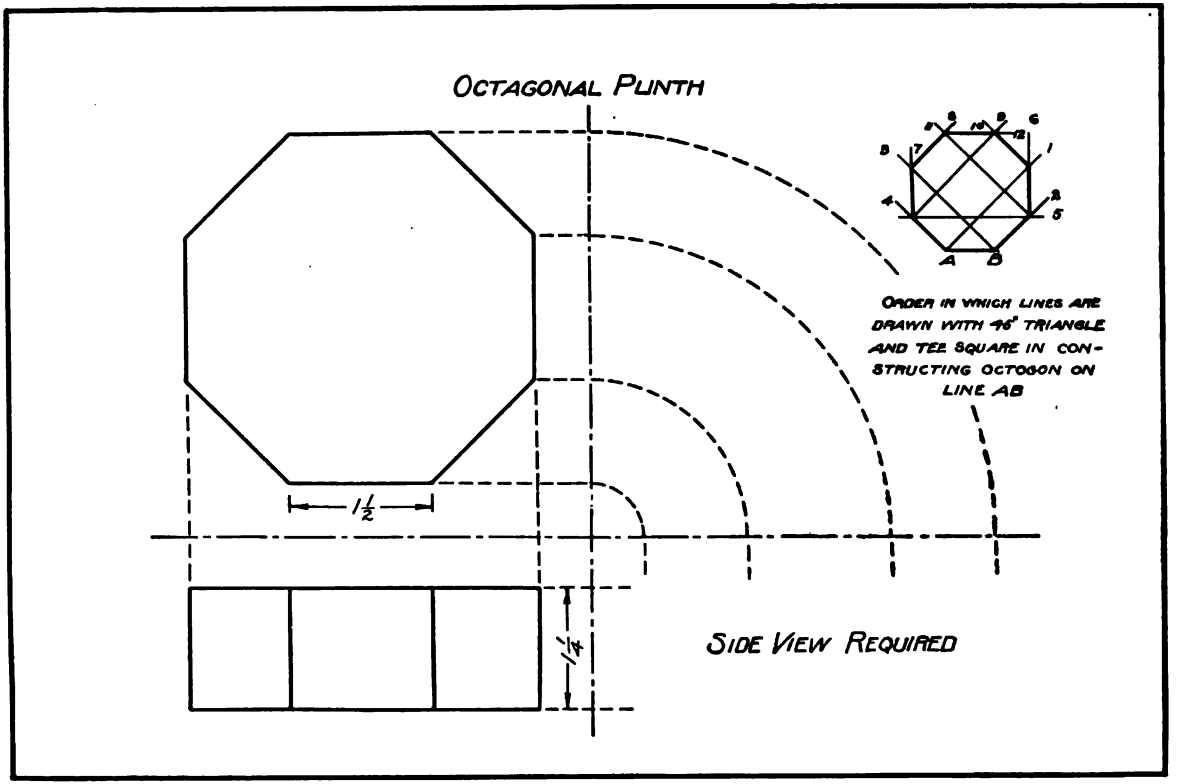

OCTAGONAL PLINTH
ORDER IN WHICH LINES ARE DRAWN WITH 45° TRIANGLE AND TEE SQUARE IN CONSTRUCTING OCTOGON ON LINE AB
1/2
1/4
SIDE VIEW REQUIRED

PLATE 29

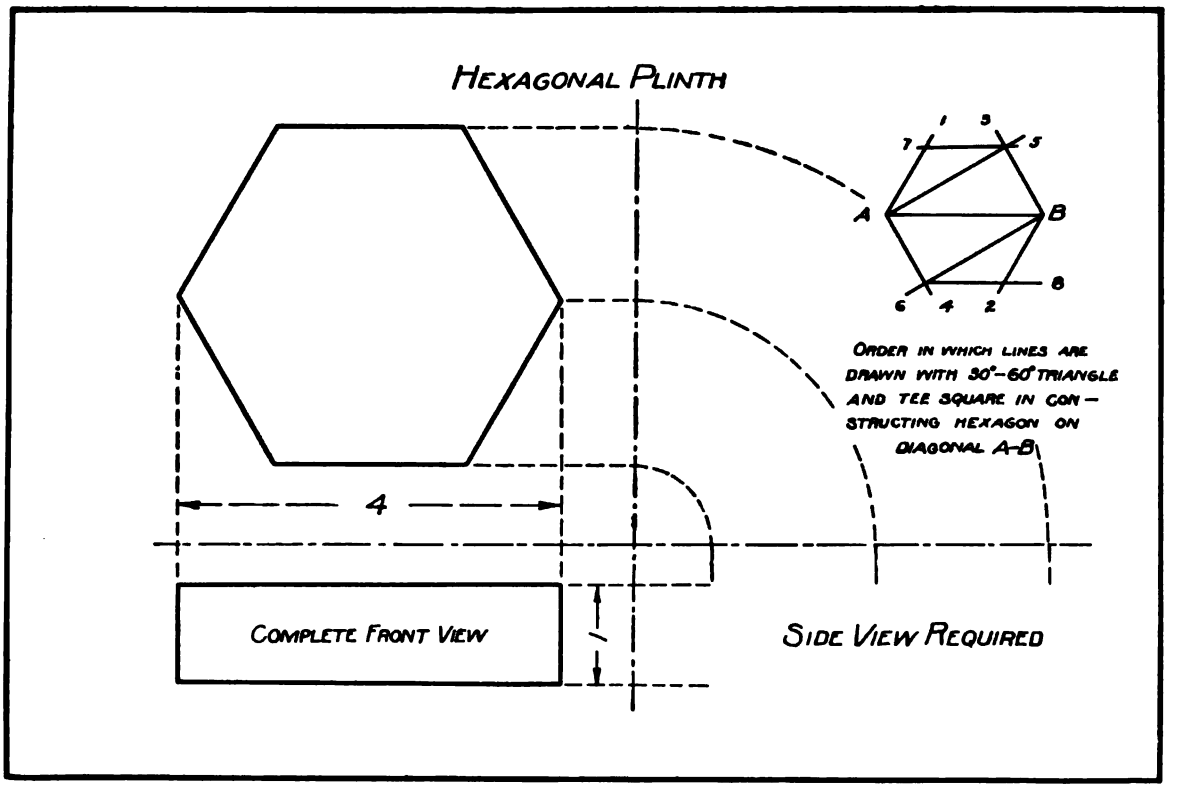

HEXAGONAL PLINTH
1
3
5
7
A
B
8
6
4
2
ORDER IN WHICH LINES ARE DRAWN WITH 30°-60° TRIANGLE AND TEE SQUARE IN CONSTRUCTING HEXAGON ON DIAGONAL A-B
4
COMPLETE FRONT VIEW
SIDE VIEW REQUIRED

PLATE 30

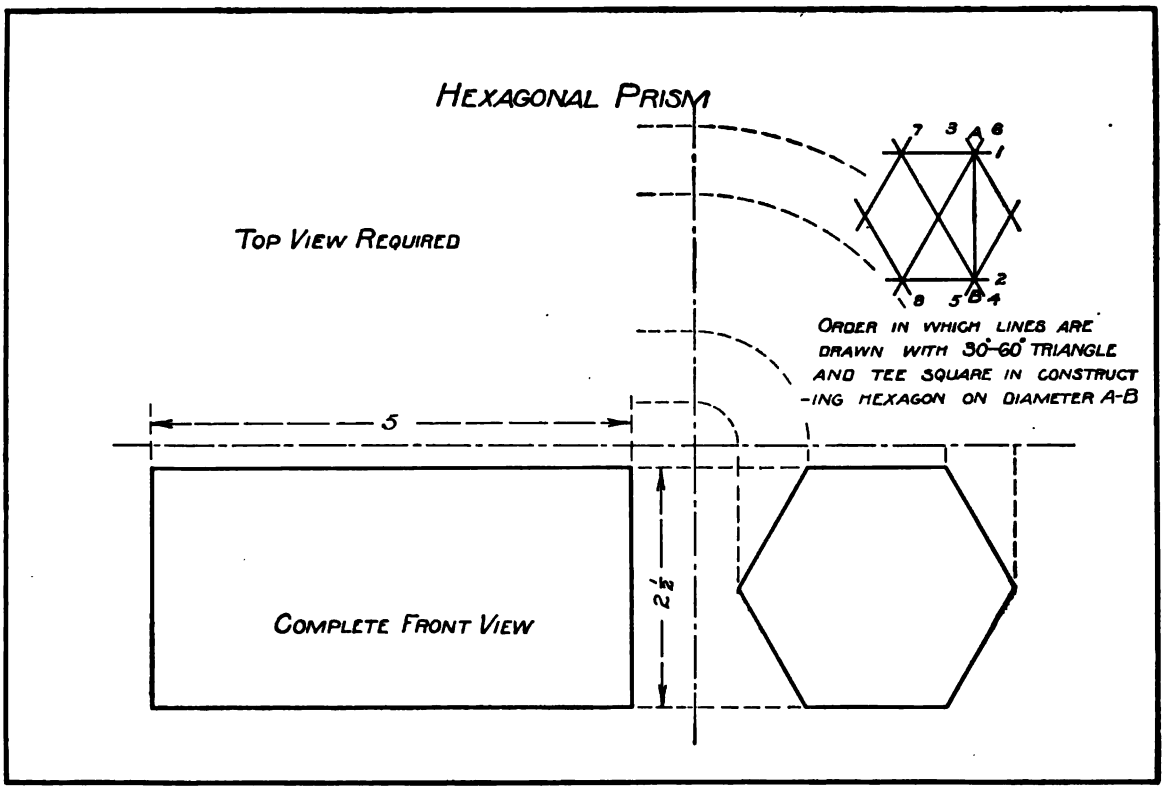

HEXAGONAL PRISM
TOP VIEW REQUIRED
7
3
A
6
1
2
8
5
B
4
ORDER IN WHICH LINES ARE DRAWN WITH 30°-60° TRIANGLE AND TEE SQUARE IN CONSTRUCTING HEXAGON ON DIAMETER A-B
5
2½
COMPLETE FRONT VIEW

PLATE 31

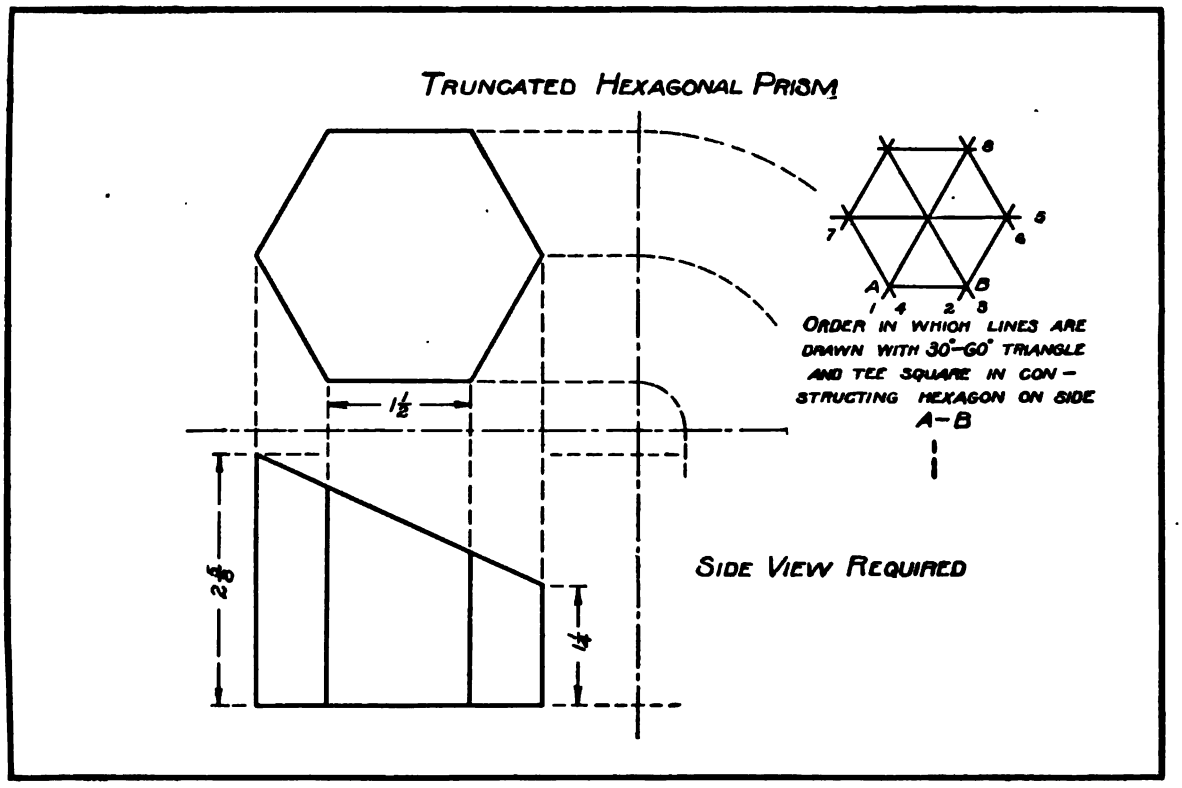

TRUNCATED HEXAGONAL PRISM
1½
2½
4
8
5
7
6
A
B
1 4 2 3
ORDER IN WHICH LINES ARE DRAWN WITH 30°-60° TRIANGLE AND TEE SQUARE IN CONSTRUCTING HEXAGON ON SIDE A-B
SIDE VIEW REQUIRED

PLATE 32

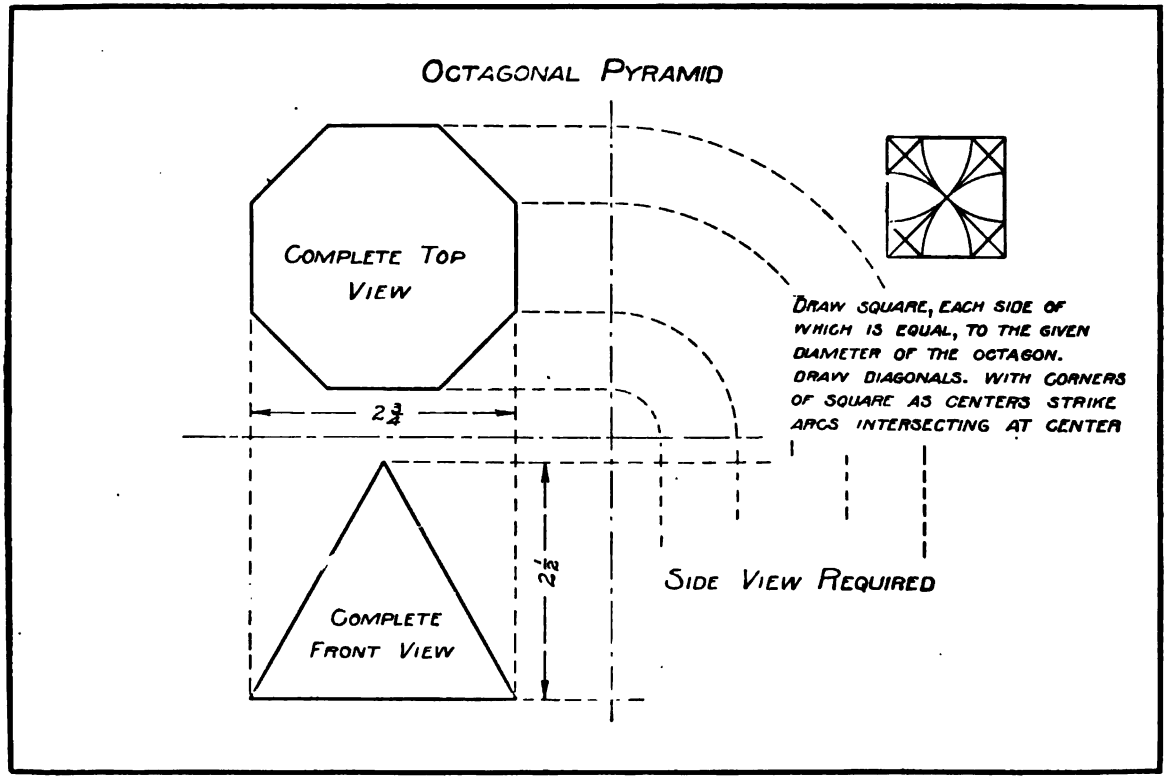

OCTAGONAL PYRAMID
COMPLETE TOP VIEW
2¾
2¾
COMPLETE FRONT VIEW
DRAW SQUARE, EACH SIDE OF WHICH IS EQUAL, TO THE GIVEN DIAMETER OF THE OCTAGON. DRAW DIAGONALS. WITH CORNERS OF SQUARE AS CENTERS STRIKE ARCS INTERSECTING AT CENTER
SIDE VIEW REQUIRED

PLATE 33

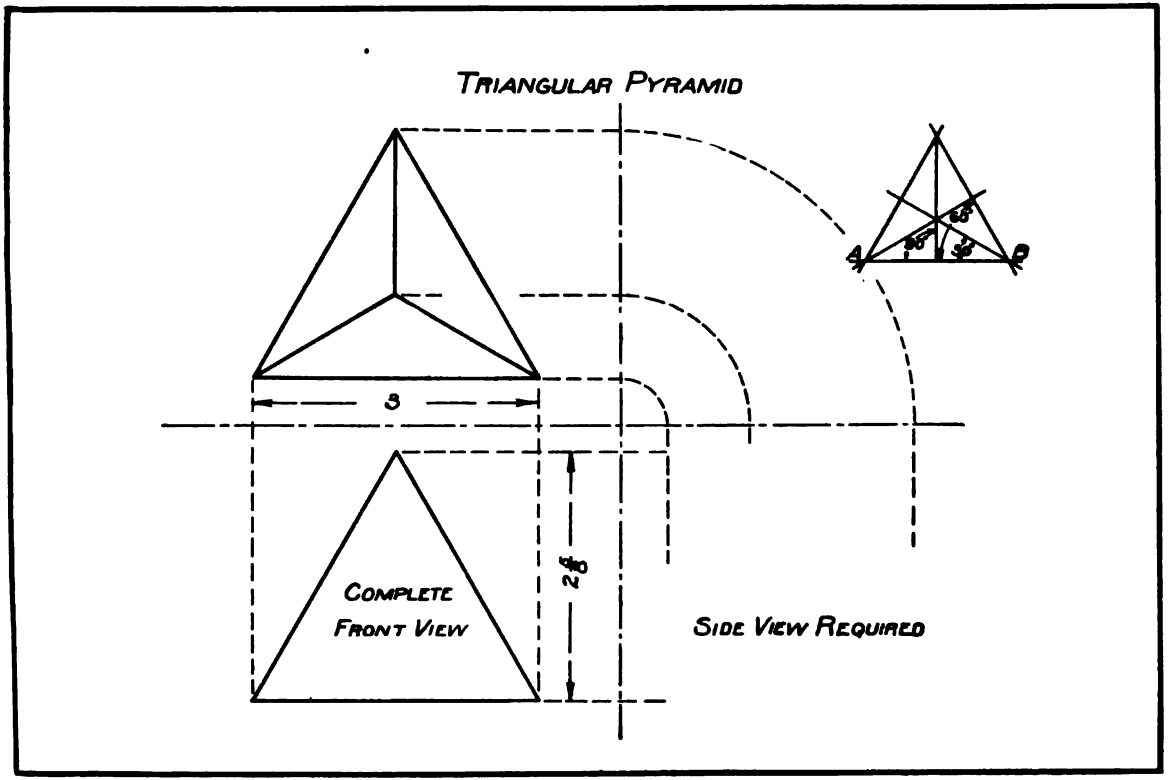

TRIANGULAR PYRAMID
3
2.6
COMPLETE
FRONT VIEW
SIDE VIEW REQUIRED
A
B
60°
30°

PLATE 34

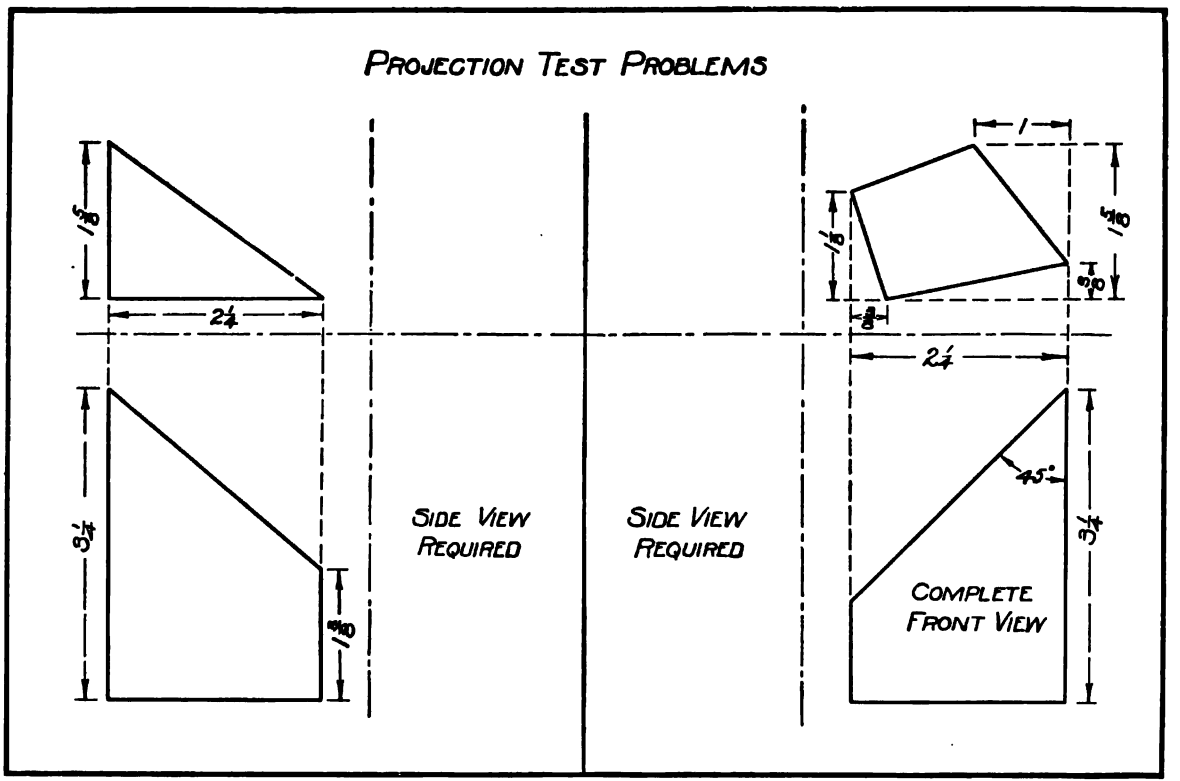

PROJECTION TEST PROBLEMS
1⅝
2¼
3¼
⅝
SIDE VIEW REQUIRED
SIDE VIEW REQUIRED
1
1⅝
1⅝
⅝
⅜
2¼
45°
3¼
COMPLETE FRONT VIEW

PLATE 35

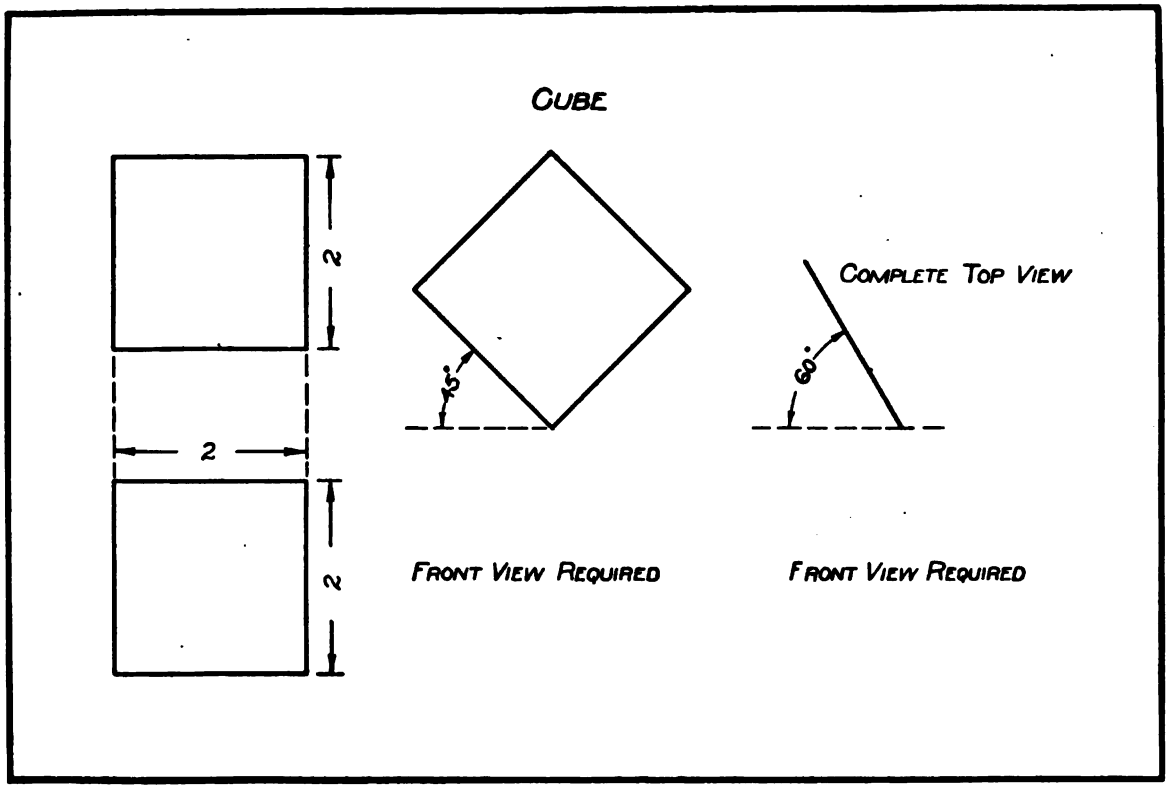

CUBE
2
2
2
45°
FRONT VIEW REQUIRED
COMPLETE TOP VIEW
60°
FRONT VIEW REQUIRED

PLATE 36

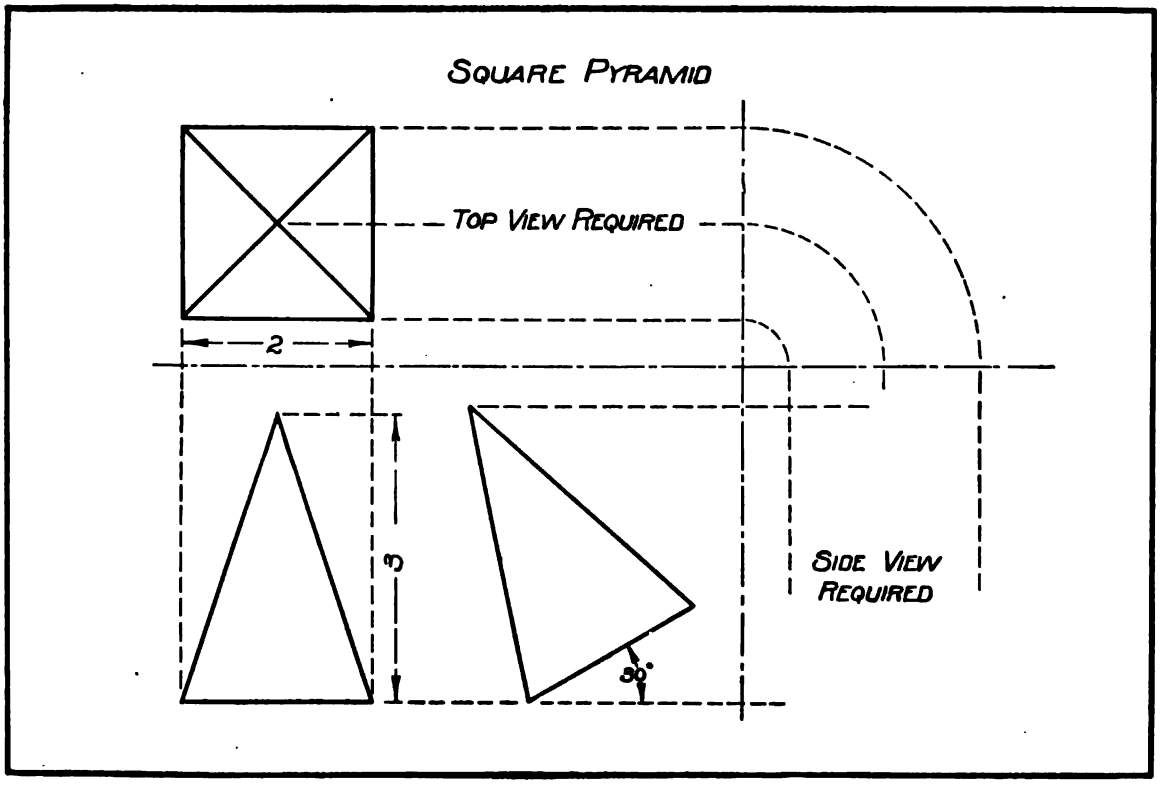


PLATE 37

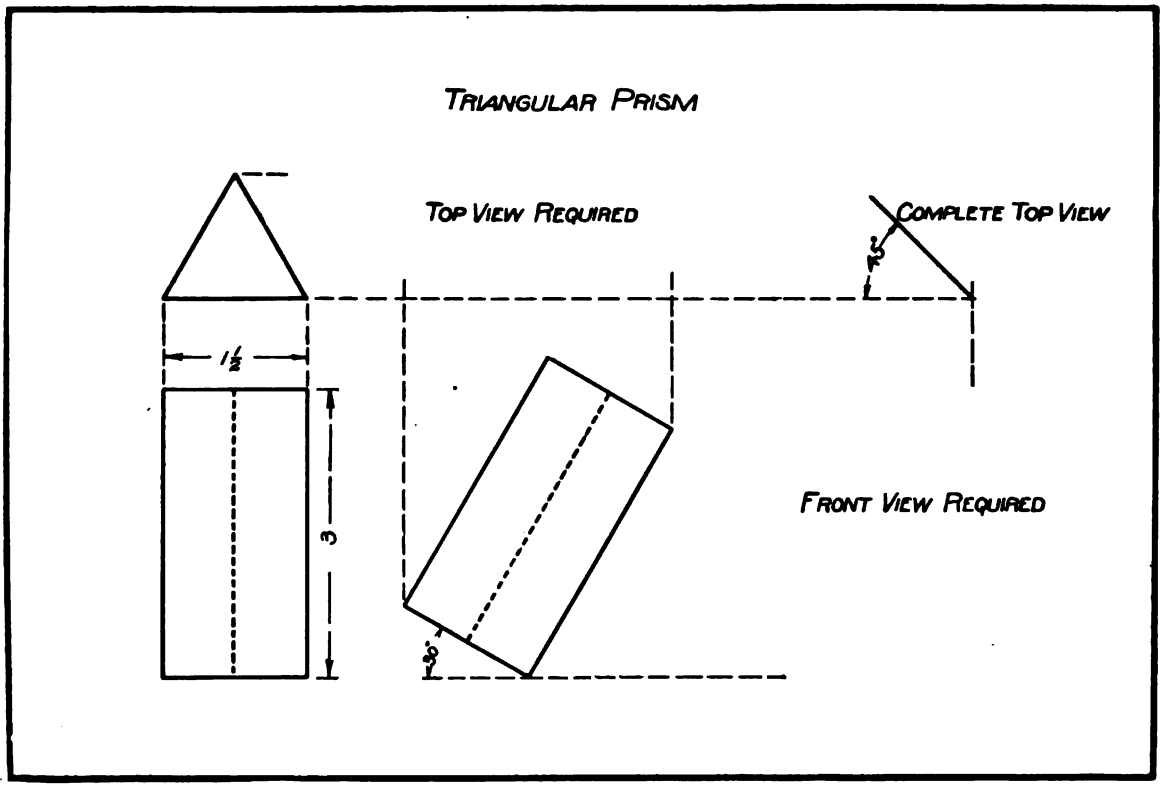

TRIANGULAR PRISM
TOP VIEW REQUIRED
COMPLETE TOP VIEW
45°
1½
3
30°
FRONT VIEW REQUIRED

PLATE 38

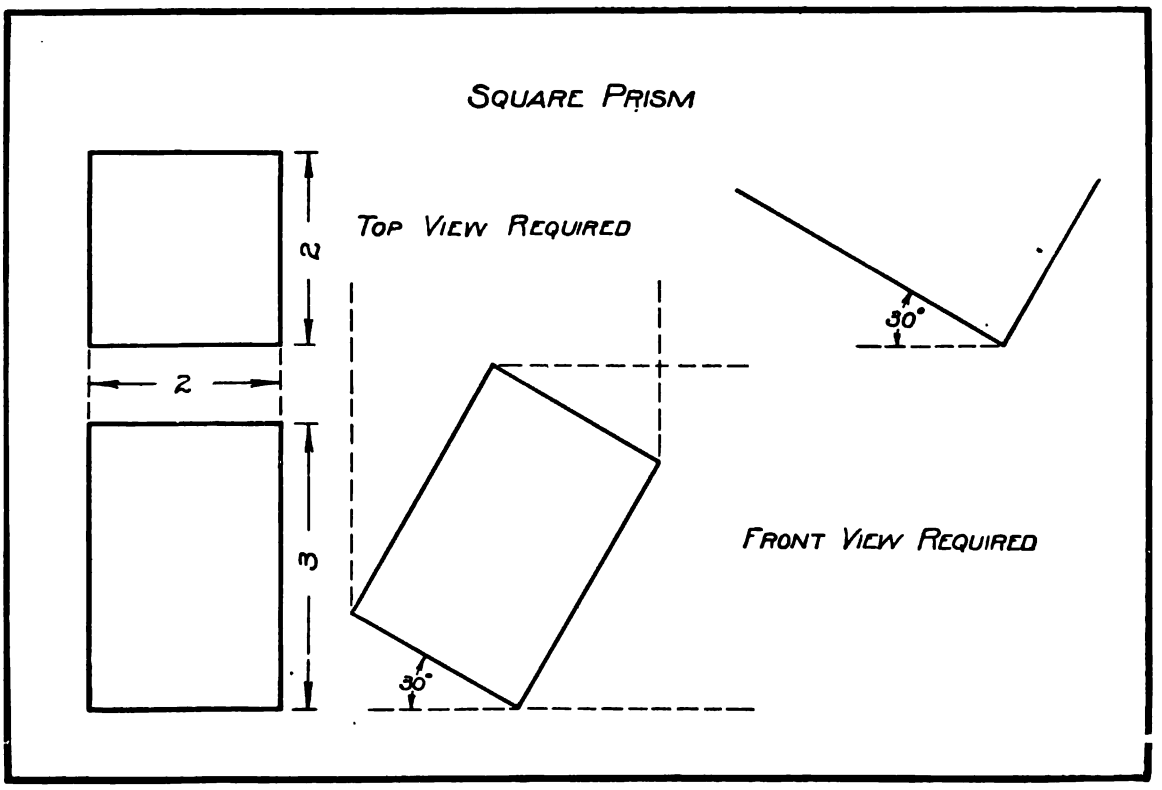

SQUARE PRISM
TOP VIEW REQUIRED
2
2
3
30°
30°
FRONT VIEW REQUIRED

PLATE 39

VE

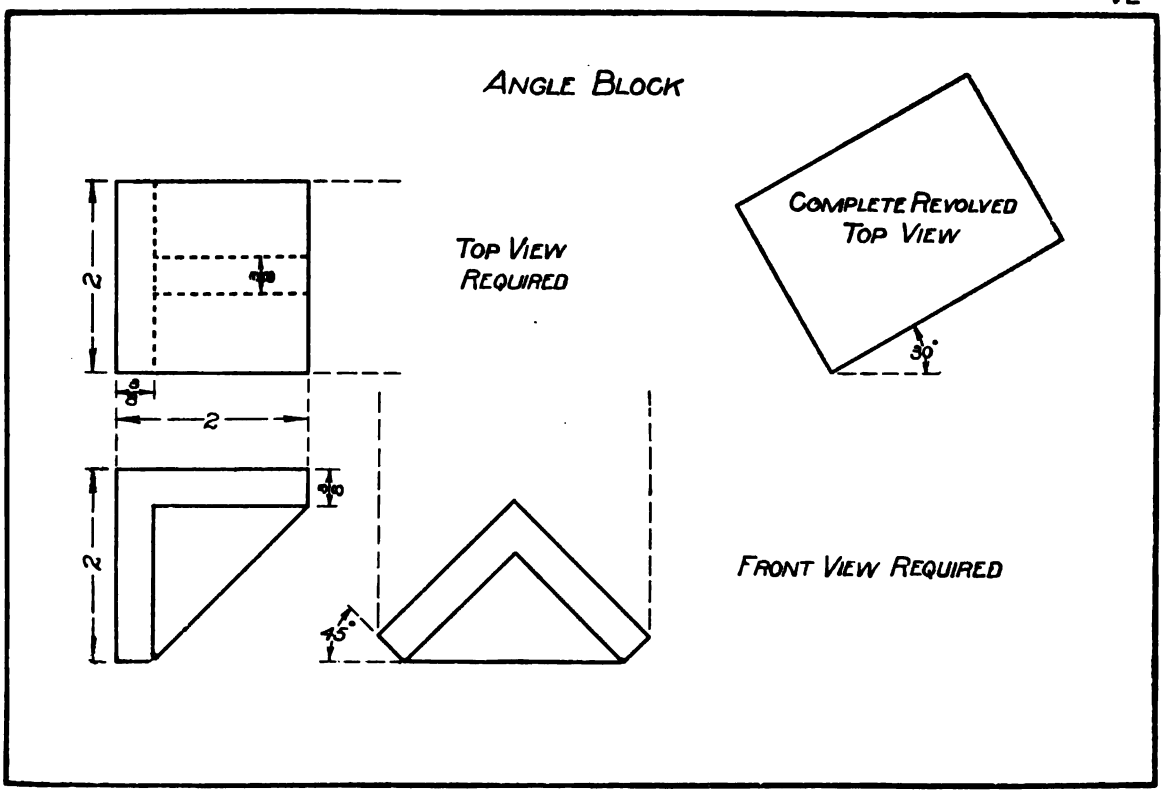

ANGLE BLOCK
2
2
2
TOP VIEW
REQUIRED
COMPLETE REVOLVED
TOP VIEW
30°
45°
FRONT VIEW REQUIRED

PLATE 40

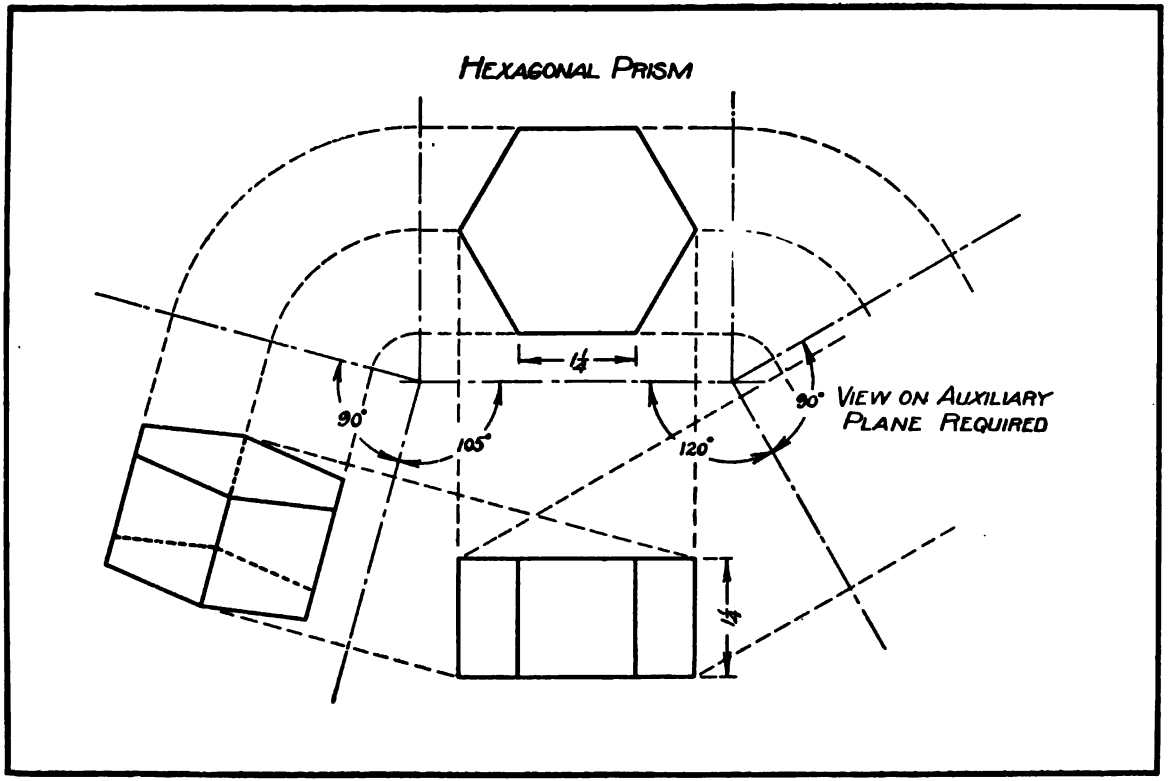

HEXAGONAL PRISM
4
90°
105°
120°
90°
VIEW ON AUXILIARY PLANE REQUIRED
4

PLATE 41

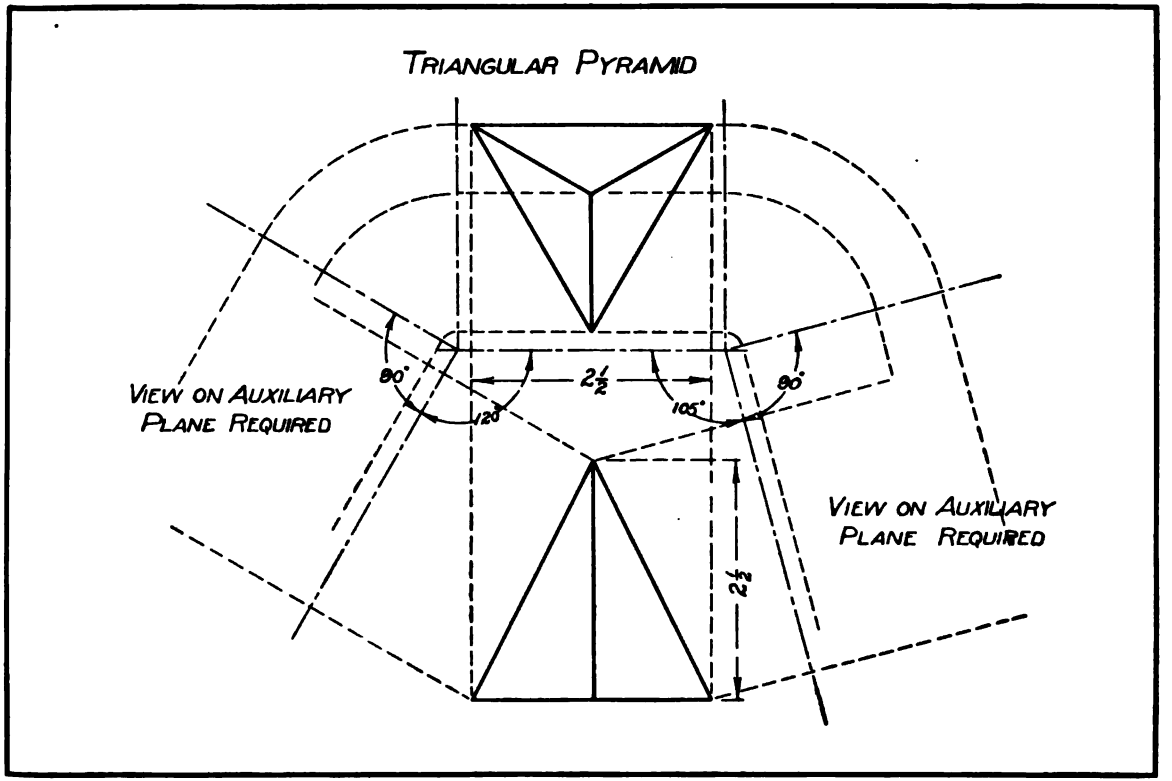

TRIANGULAR PYRAMID
VIEW ON AUXILIARY PLANE REQUIRED
90°
120°
2½
105°
90°
2½
VIEW ON AUXILIARY PLANE REQUIRED

PLATE 42

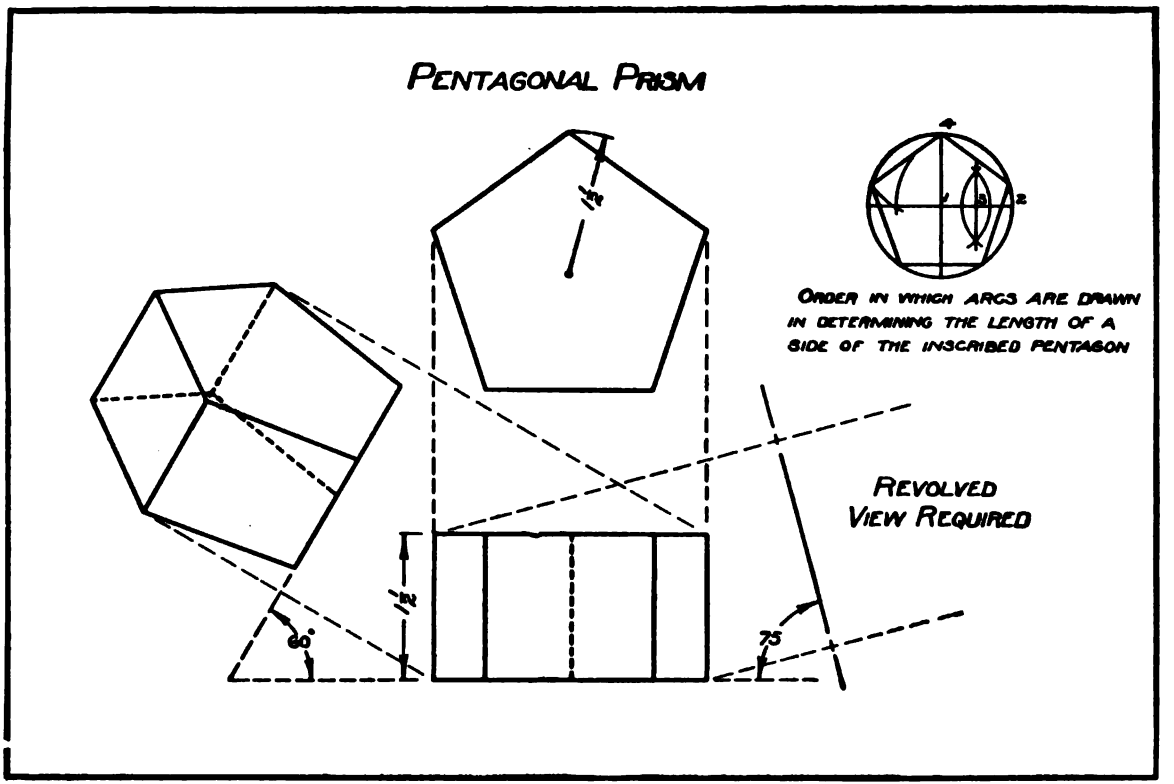

PENTAGONAL PRISM
1½
1½
60°
75
4
1
2
3
ORDER IN WHICH ARCS ARE DRAWN IN DETERMINING THE LENGTH OF A SIDE OF THE INSCRIBED PENTAGON
REVOLVED VIEW REQUIRED

PLATE 43

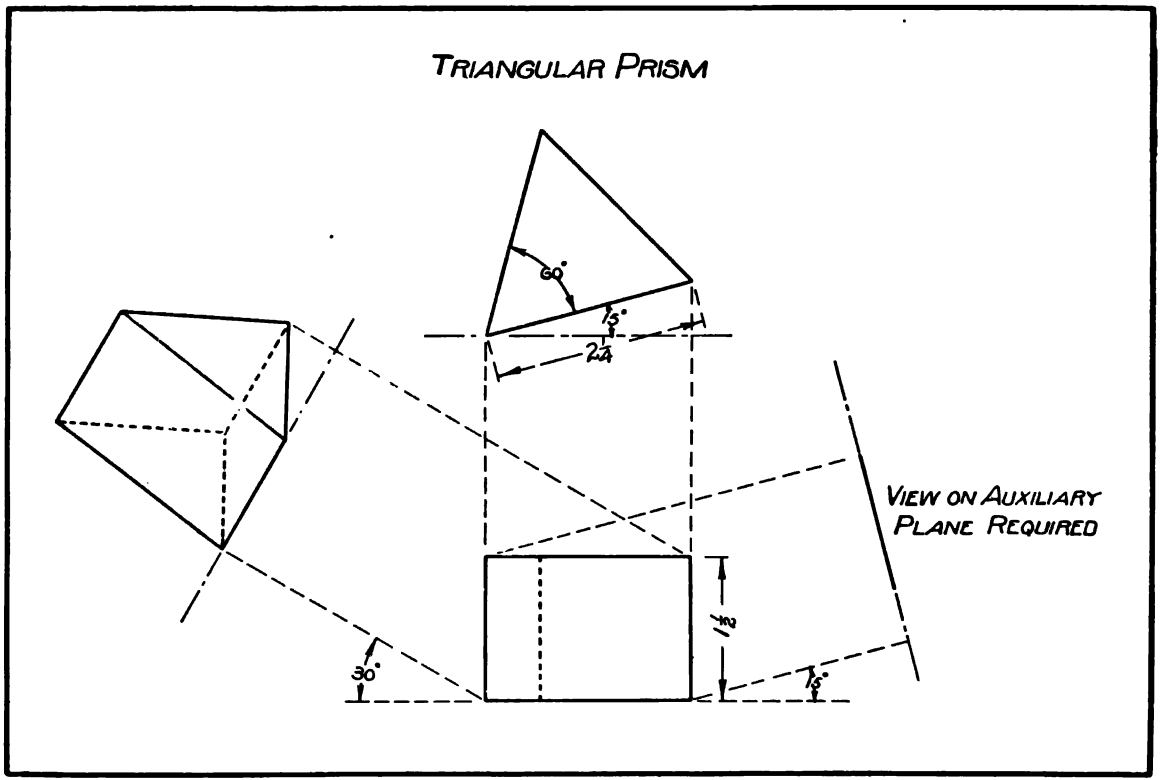

TRIANGULAR PRISM
60°
1/2"
2 1/4"
VIEW ON AUXILIARY PLANE REQUIRED
1 1/2"
30°
1/2"

PLATE 44

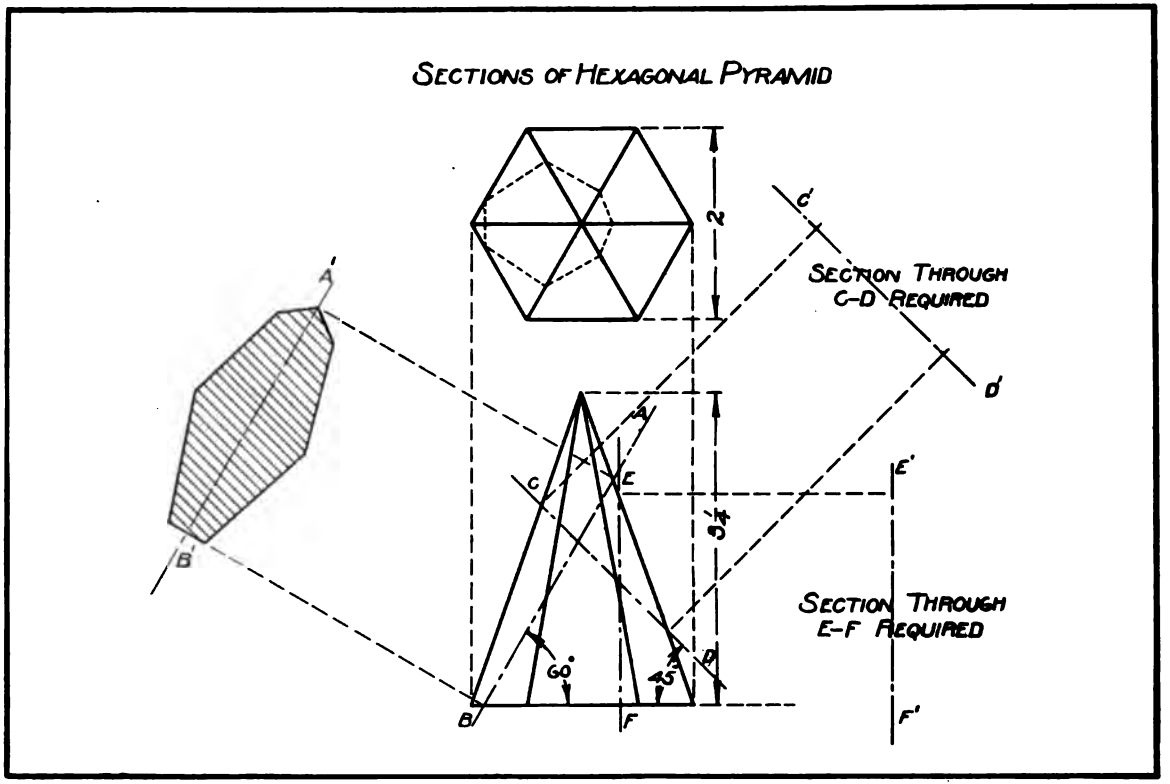

SECTIONS OF HEXAGONAL PYRAMID
2
C'
SECTION THROUGH
C-D REQUIRED
D'
A'
B'
A
C
E
E'
3¼
SECTION THROUGH
E-F REQUIRED
60°
45°
D
B
F
F'

PLATE 45

VL

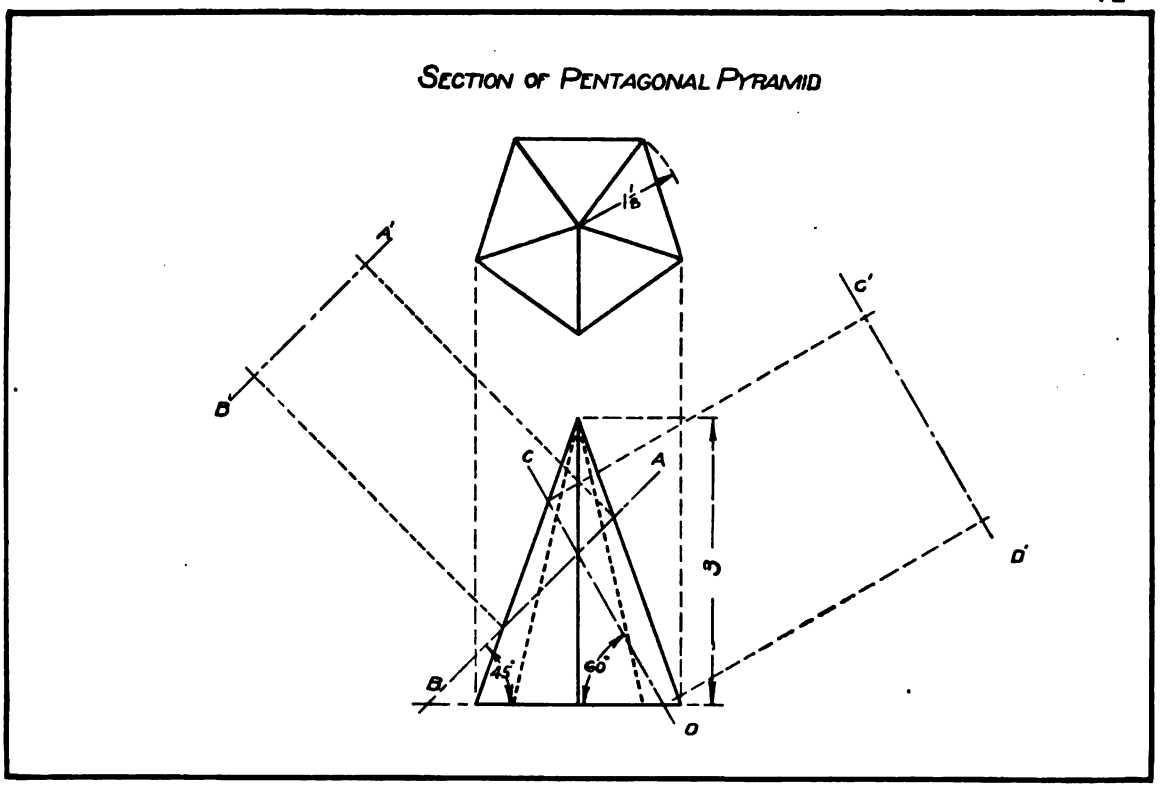
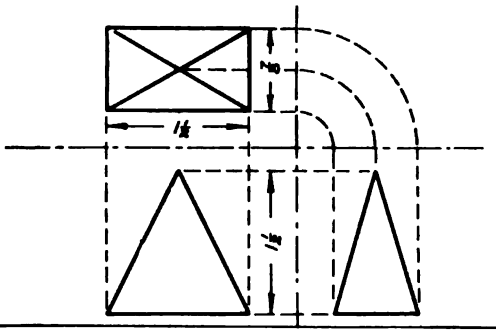


PLATE 46

TEST PROBLEMS IN REVOLUTIONS



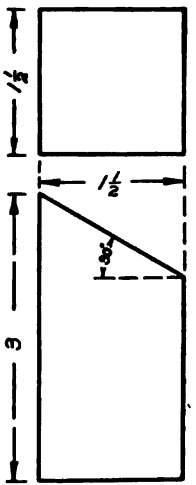
B– DRAW THREE VIEWS OF THE PYRAMID WHEN REVOLVED FROM THE GIVEN POSITION 30° TO THE LEFT ABOUT AN AXIS PERPENDICULAR TO THE VERTICAL PLANE

C– DRAW THREE VIEWS OF THE PYRAMID WHEN REVOLVED FROM ITS POSITION IN B 15° ABOUT AN AXIS PERPENDICULAR TO THE HORIZONTAL PLANE

D–DRAW THREE VIEWS OF THE PYRAMID WHEN REVOLVED FROM ITS POSITION IN B 30° FORWARD ABOUT AN AXIS PARALLEL TO THE INTERSECTION OF THE HORIZONTAL AND VERTICAL PLANES

PLATE 47

TRUNCATED SQUARE PRISM



DEVELOPMENT REQUIRED

PLATE 48

Truncated Square Prism

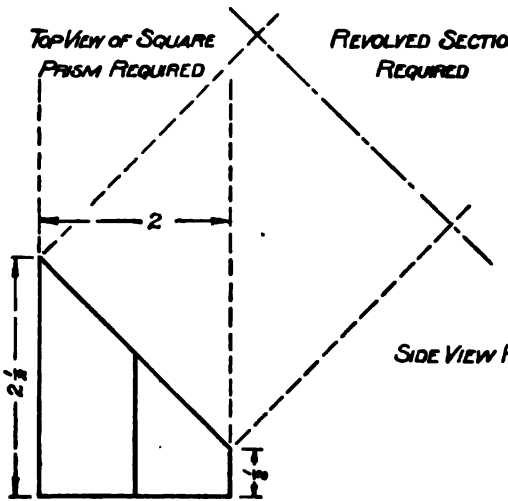


Plate 49

VI c

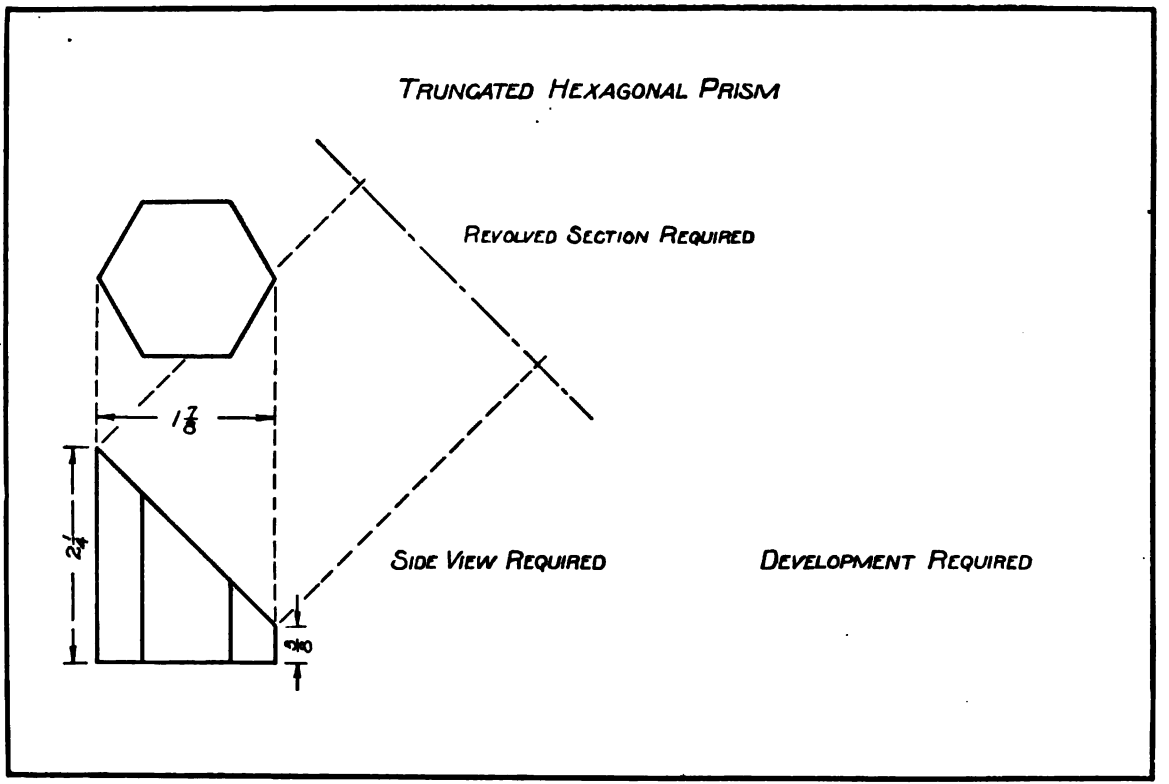

TRUNCATED HEXAGONAL PRISM
REVOLVED SECTION REQUIRED
1 7/8
2 1/4
SIDE VIEW REQUIRED
DEVELOPMENT REQUIRED

PLATE 50

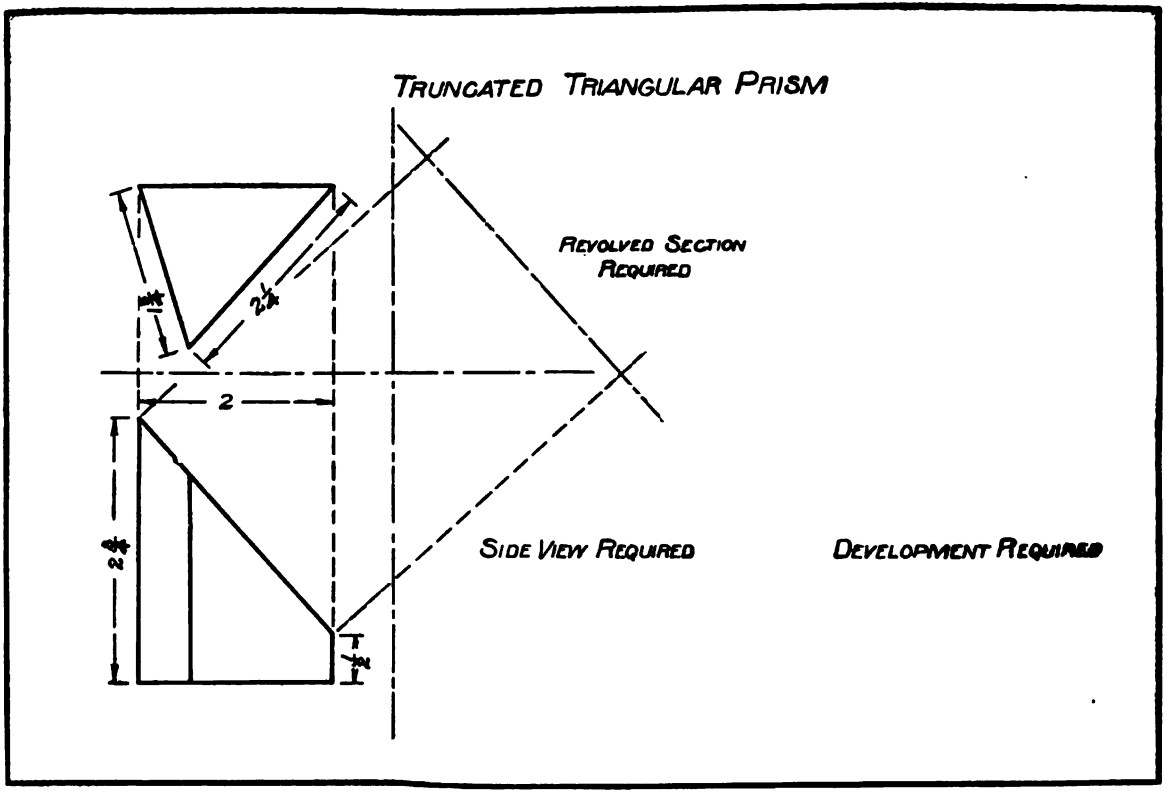

TRUNCATED TRIANGULAR PRISM
REVOLVED SECTION REQUIRED
2½
1¾
2
2¾
½
SIDE VIEW REQUIRED
DEVELOPMENT REQUIRED

PLATE 51

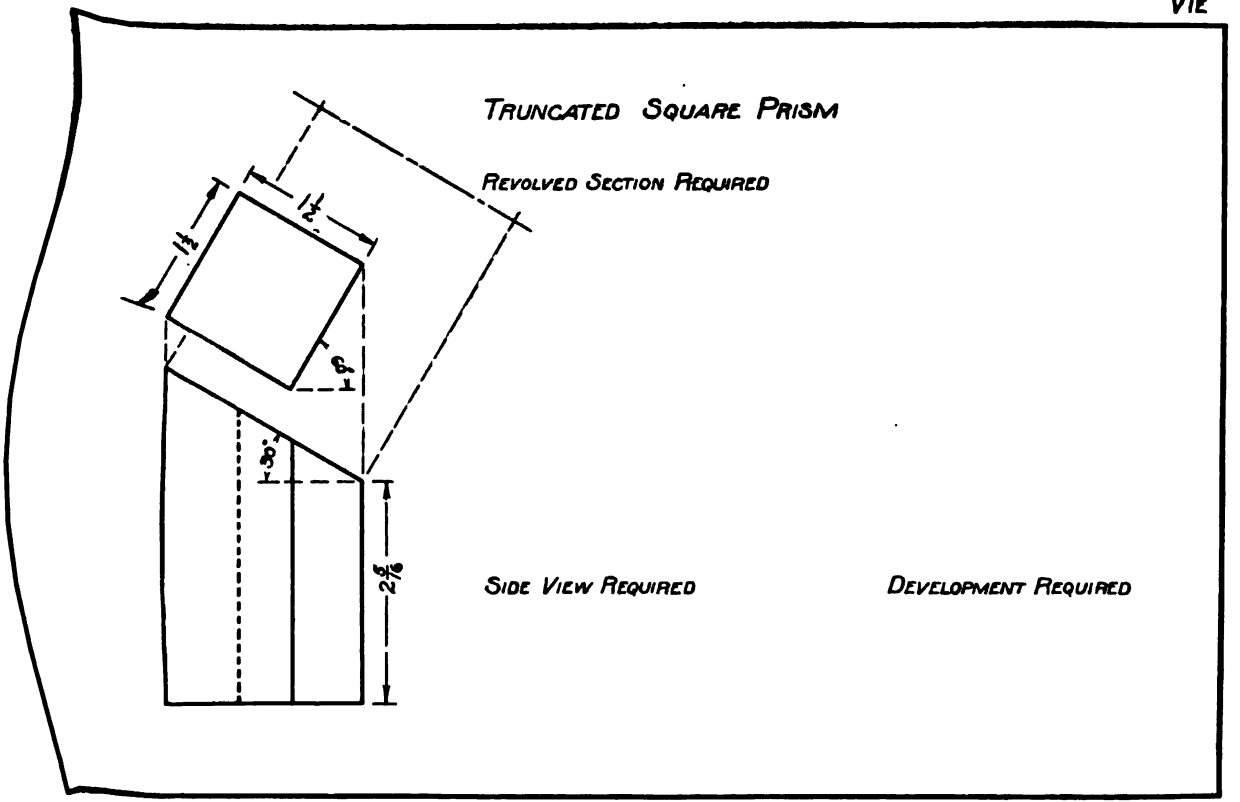

TRUNCATED SQUARE PRISM
REVOLVED SECTION REQUIRED
1½
1½
1½
30°
2⅛
SIDE VIEW REQUIRED
DEVELOPMENT REQUIRED

PLATE 52

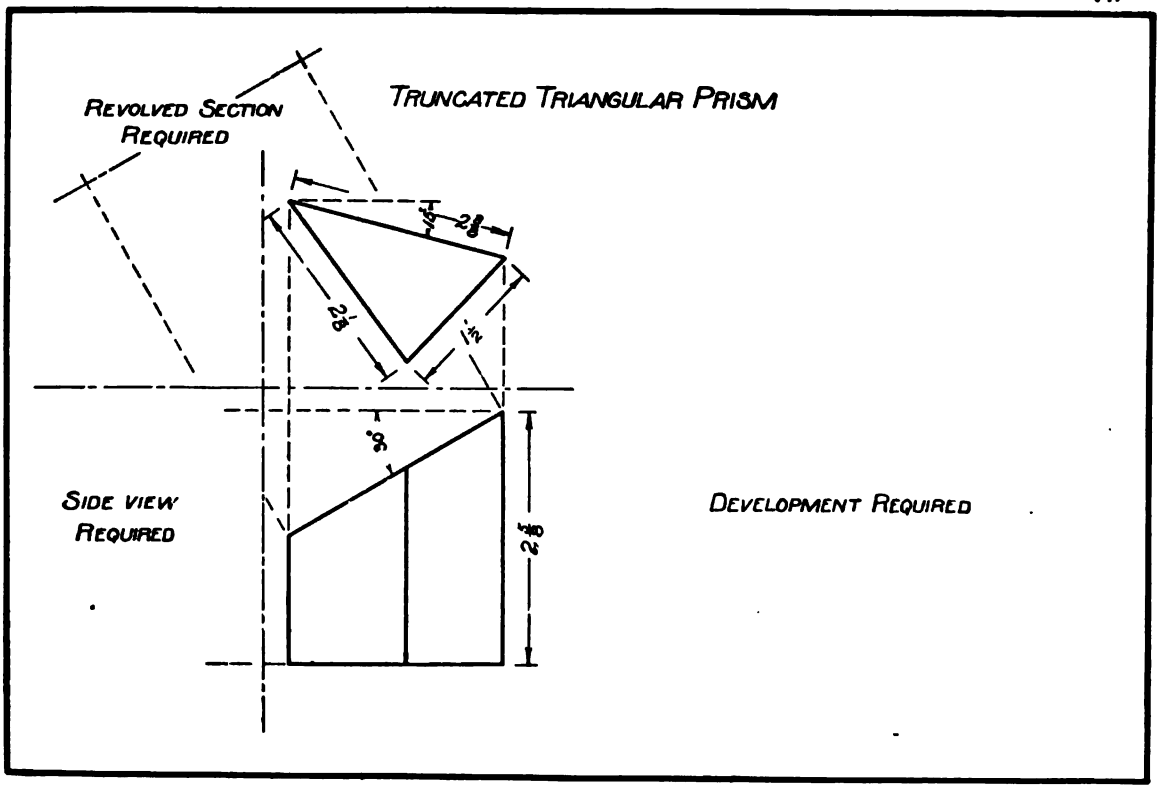

REVOLVED SECTION REQUIRED
TRUNCATED TRIANGULAR PRISM
2⅜
2½
1¾
⅜
2⅜
SIDE VIEW REQUIRED
DEVELOPMENT REQUIRED

PLATE 53

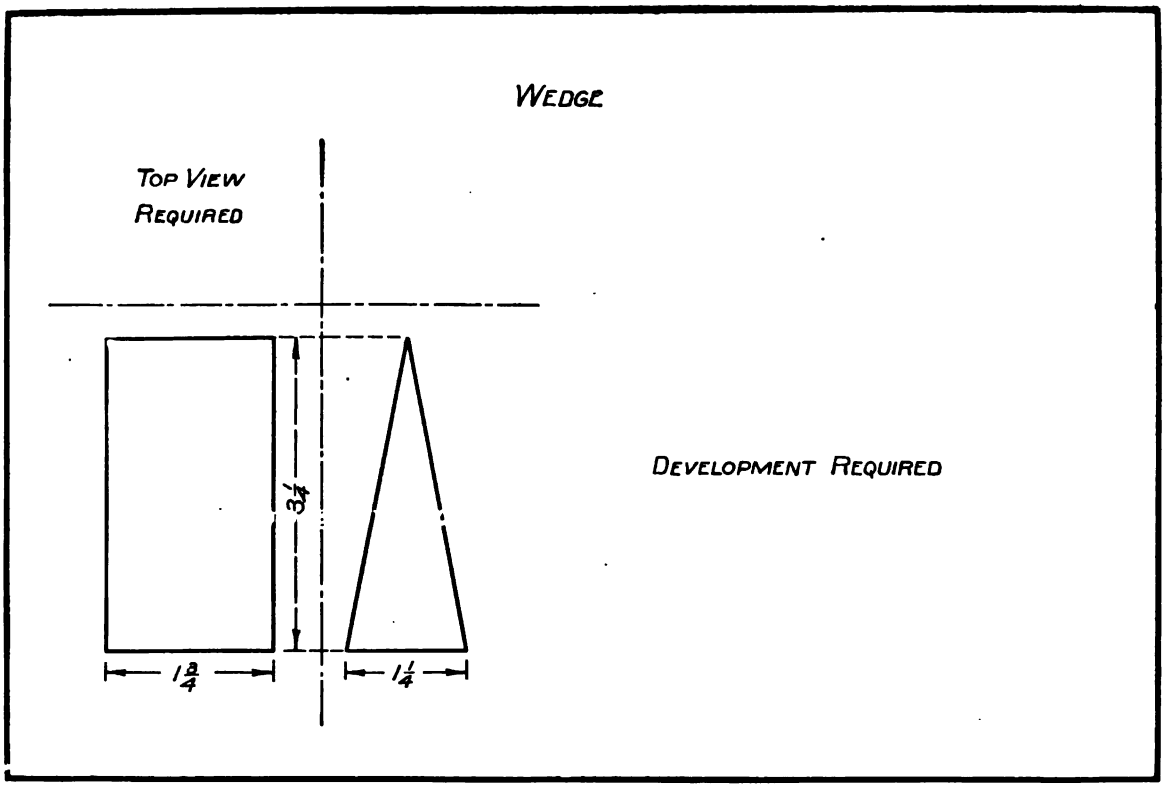
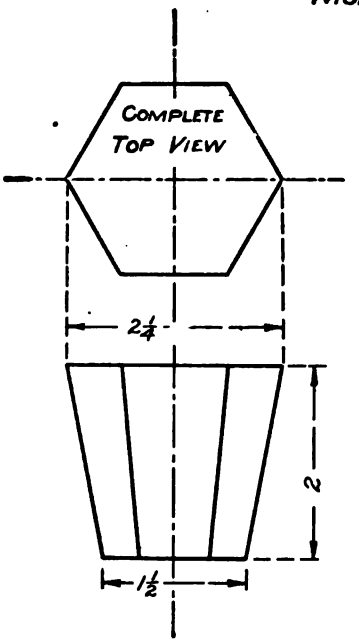


PLATE 54

Model of Waste Basket



Side View Required

Development Required

Plate 55

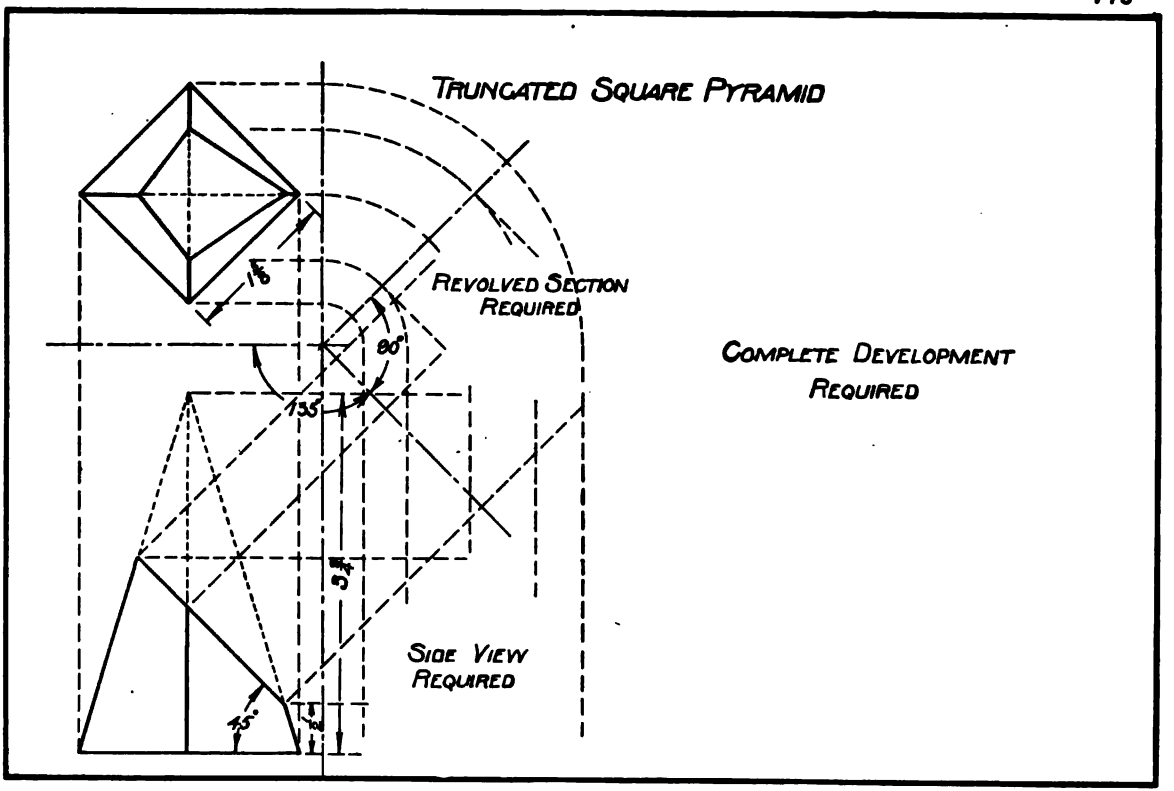

TRUNCATED SQUARE PYRAMID
1⅝
REVOLVED SECTION REQUIRED
80°
135°
5¼
SIDE VIEW REQUIRED
75°
⅝
COMPLETE DEVELOPMENT REQUIRED

PLATE 56

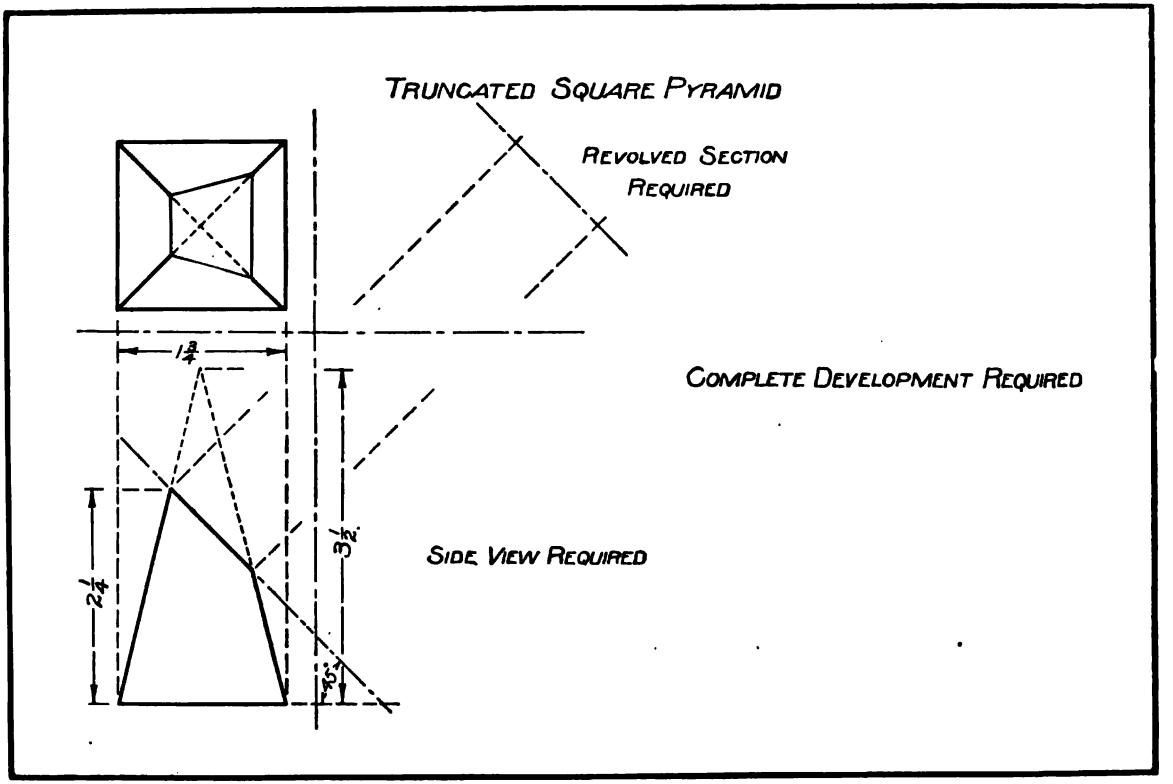

TRUNCATED SQUARE PYRAMID
REVOLVED SECTION REQUIRED
1¾
COMPLETE DEVELOPMENT REQUIRED
3½
SIDE VIEW REQUIRED
2¼
45°

PLATE 57

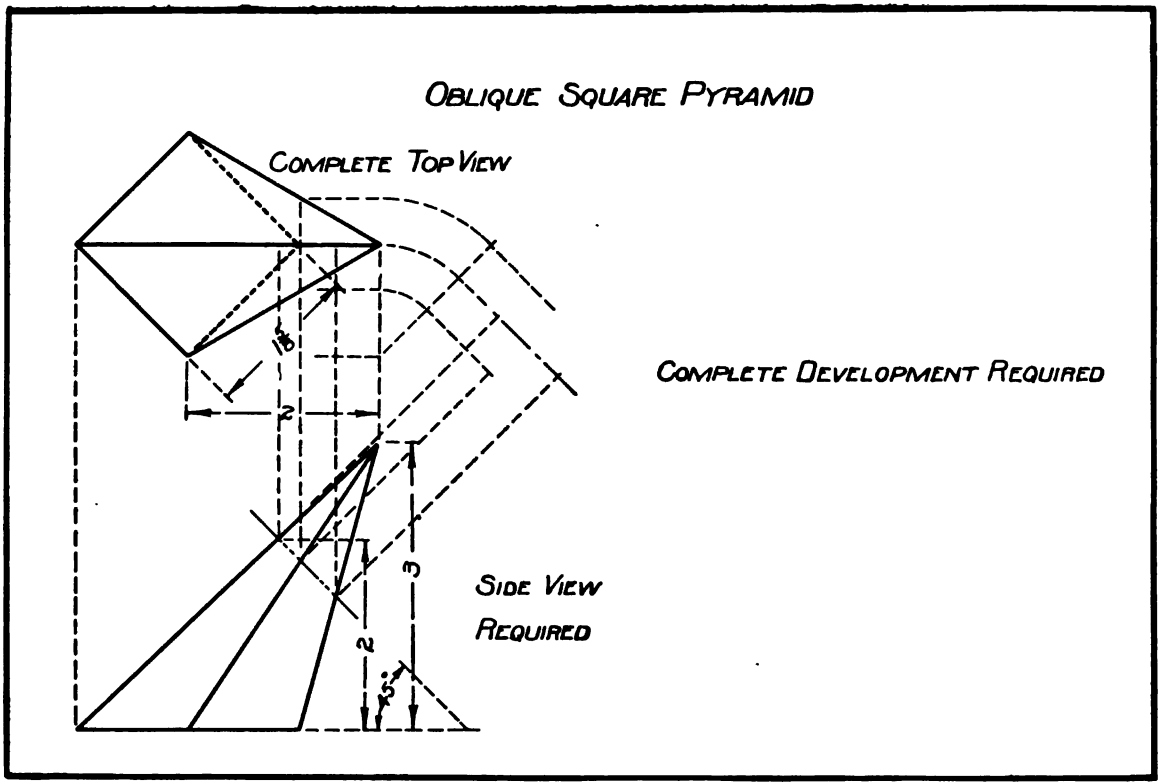
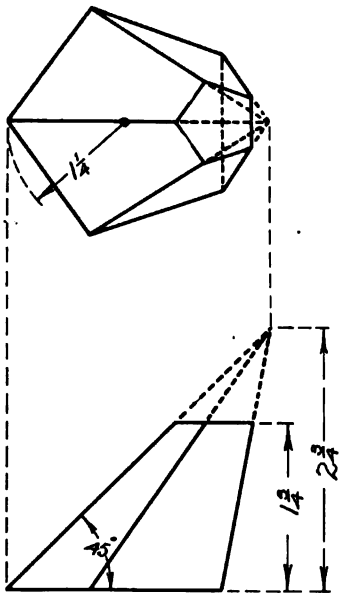

OBLIQUE SQUARE PYRAMID
COMPLETE TOP VIEW
1½
2
COMPLETE DEVELOPMENT REQUIRED
3
2
45°
SIDE VIEW
REQUIRED

PLATE 58

TRUNCATED OBLIQUE PENTAGONAL PYRAMID



COMPLETE DEVELOPMENT REQUIRED

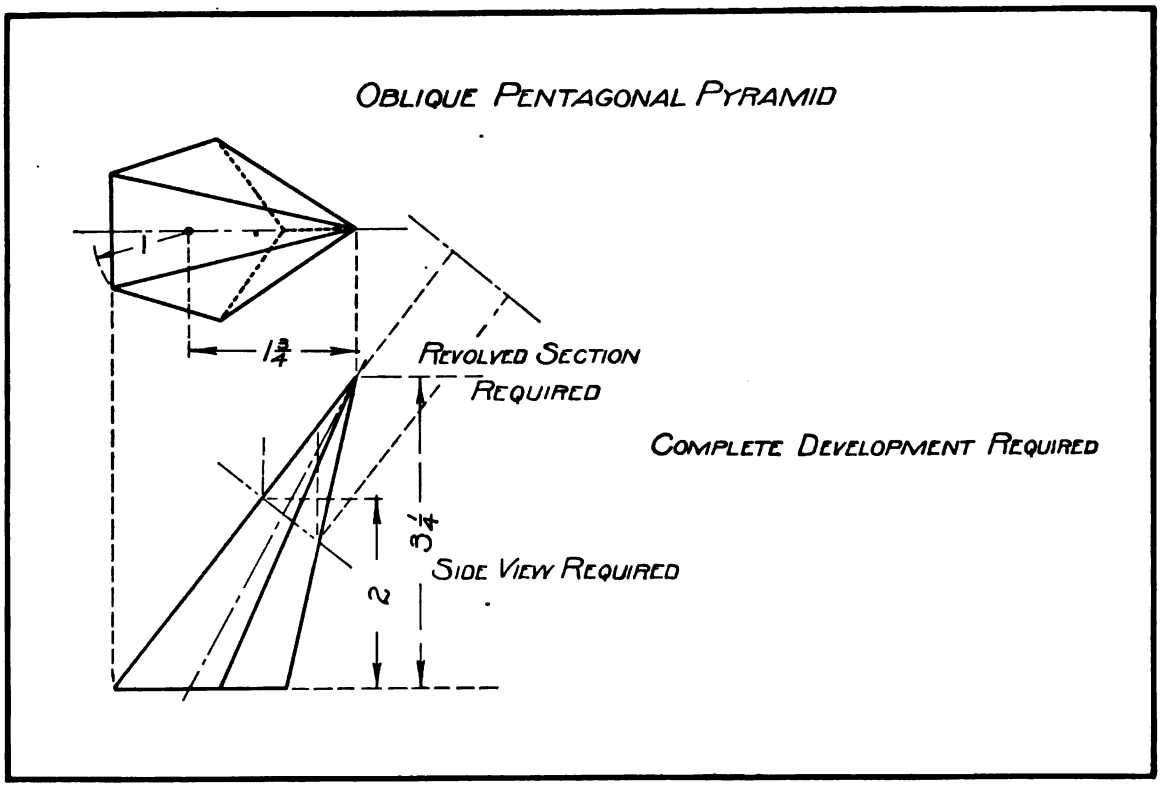

OBLIQUE PENTAGONAL PYRAMID
1
1¾
REVOLVED SECTION REQUIRED
COMPLETE DEVELOPMENT REQUIRED
3¼
2
SIDE VIEW REQUIRED

PLATE 60

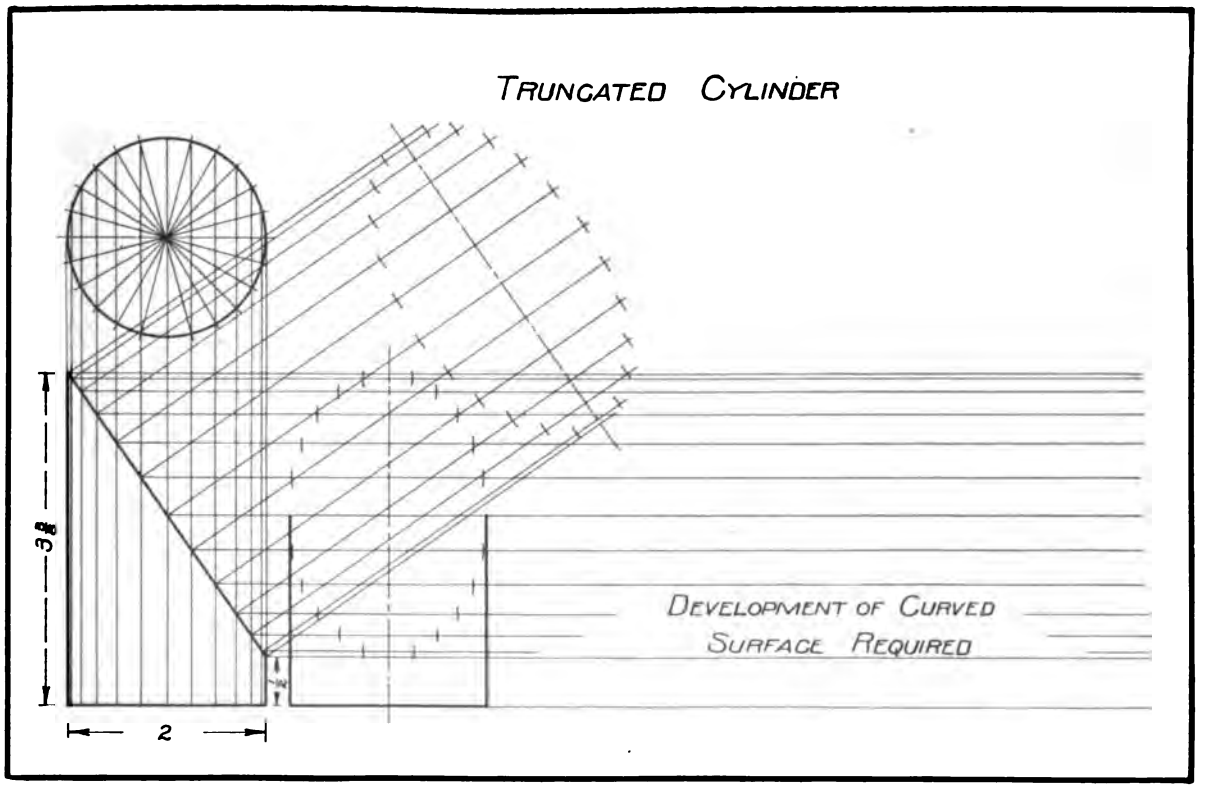
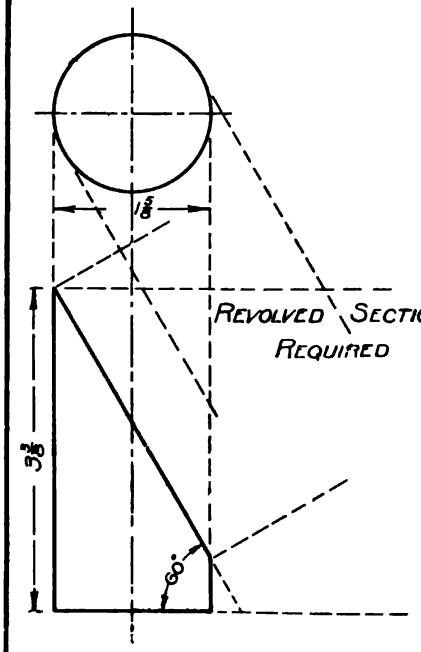

TRUNCATED CYLINDER
3
2
DEVELOPMENT OF CURVED
SURFACE REQUIRED

PLATE 61

TRUNCATED CYLINDER



REVOLVED SECTION REQUIRED

SIDE VIEW REQUIRED

DEVELOPMENT OF CURVED SURFACE REQUIRED

PLATE 62

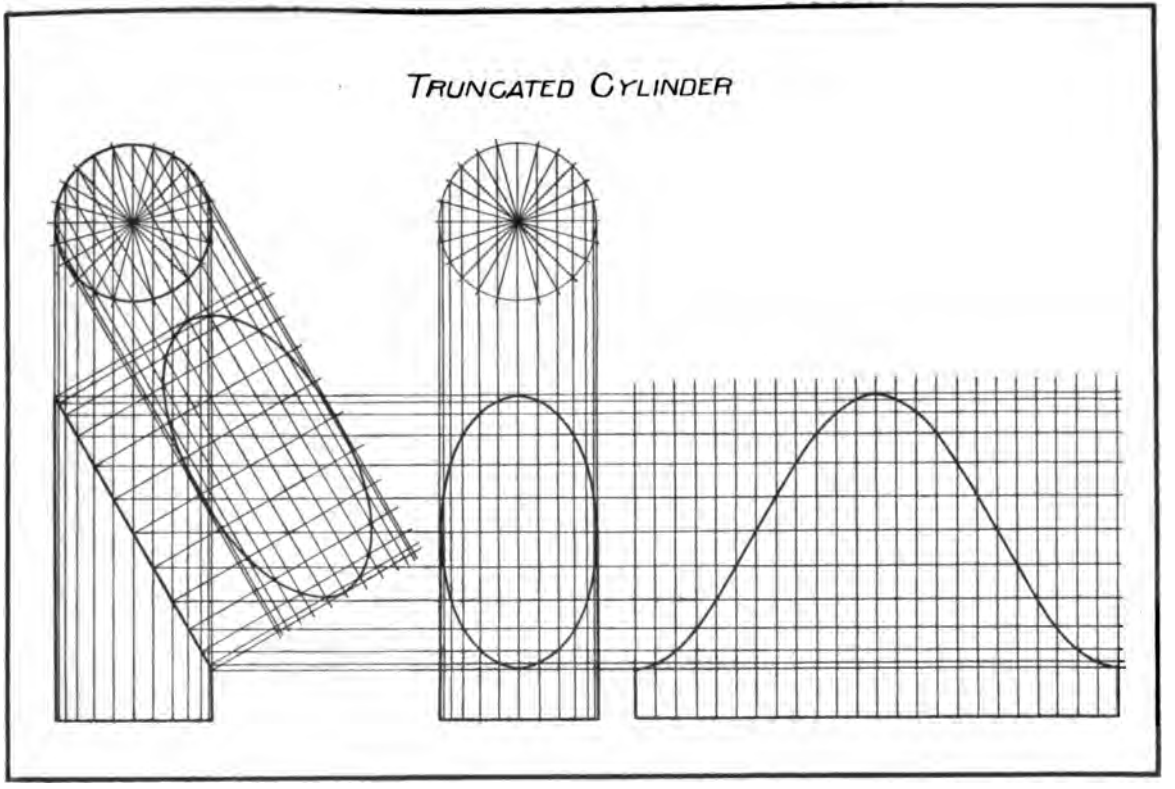
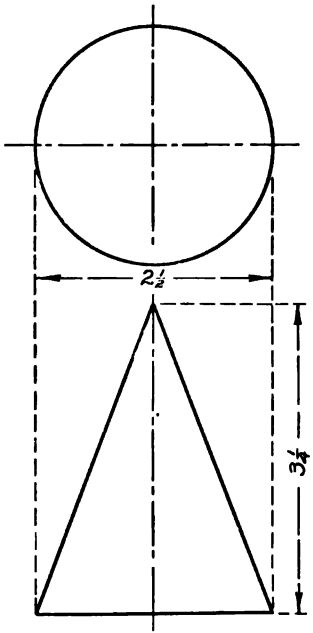


PLATE 63

CONE

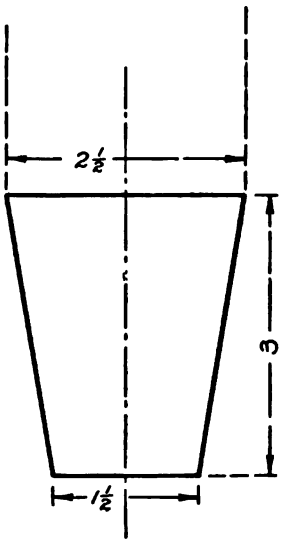


COMPLETE DEVELOPMENT REQUIRED

PLATE 64

TIN CUP

TOP VIEW REQUIRED

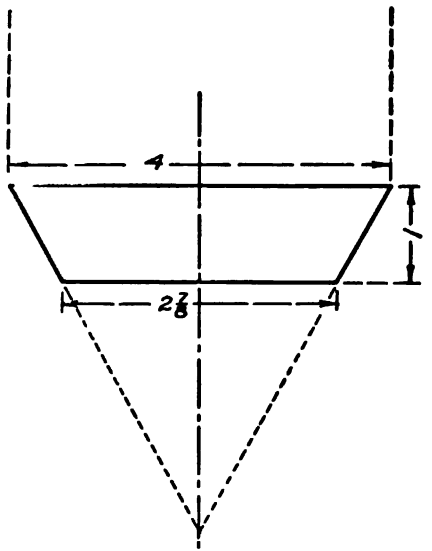


DEVELOPMENT REQUIRED

PLATE 65

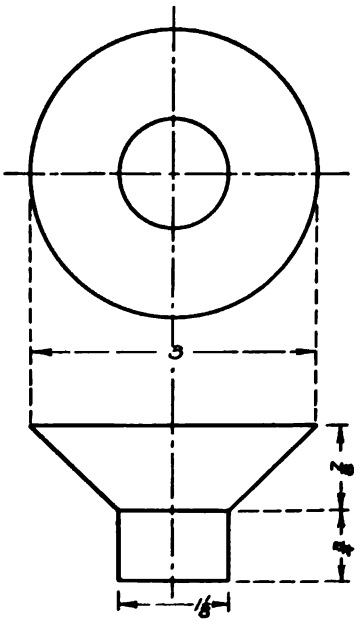
TIN PAN

TOP VIEW REQUIRED



DEVELOPMENT REQUIRED

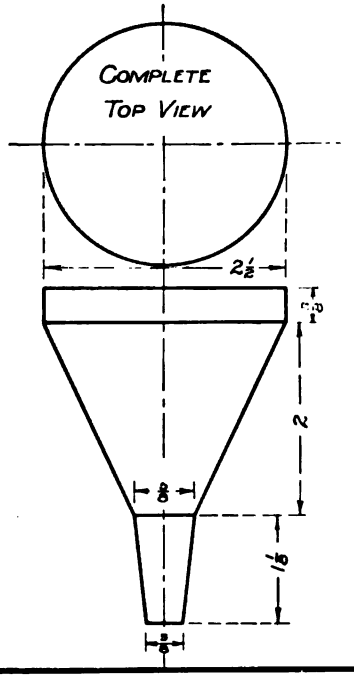
GROCER'S FUNNEL



DEVELOPMENT REQUIRED

PLATE 67

FUNNEL



DEVELOPMENT REQUIRED

PLATE 68

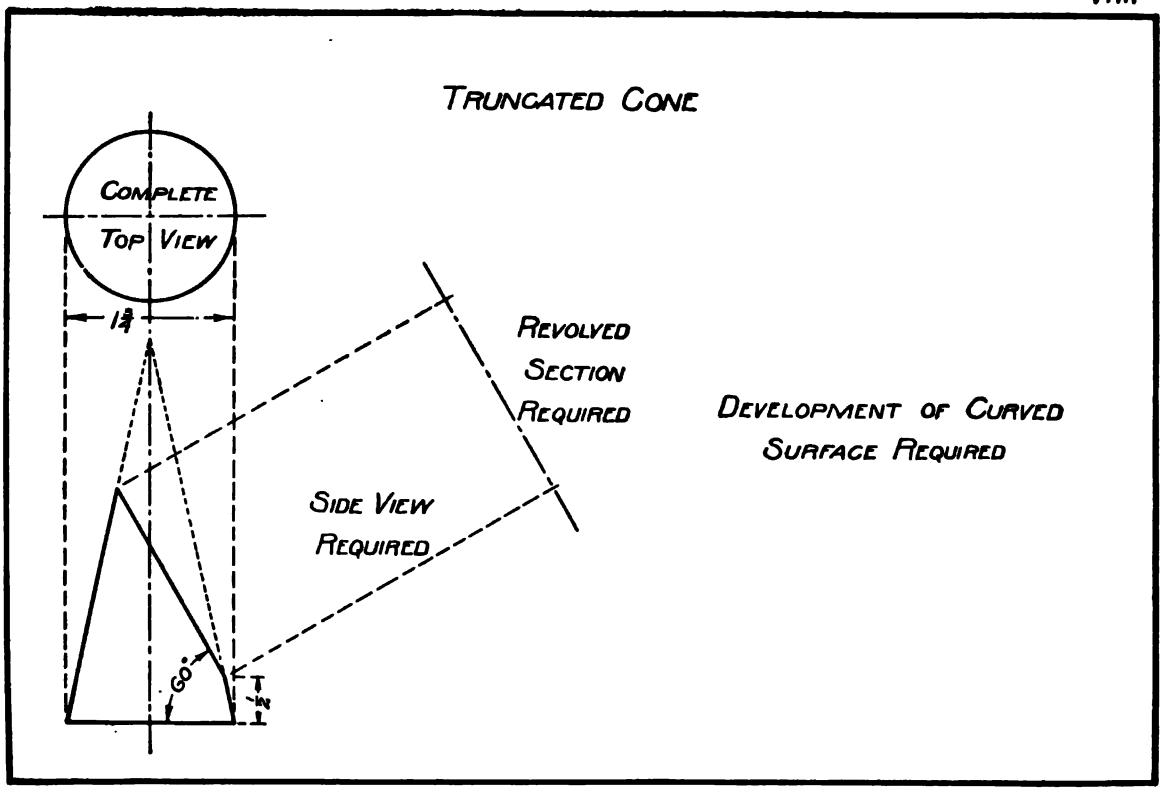
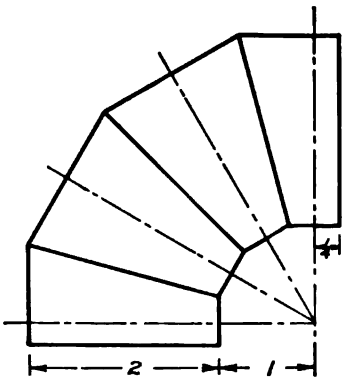

TRUNCATED CONE
COMPLETE
TOP VIEW
1¾
REVOLVED
SECTION
REQUIRED
DEVELOPMENT OF CURVED
SURFACE REQUIRED
SIDE VIEW
REQUIRED
60°
1¾

PLATE 69

Stove Pipe Elbow



Development Required

SCALE SCOOP

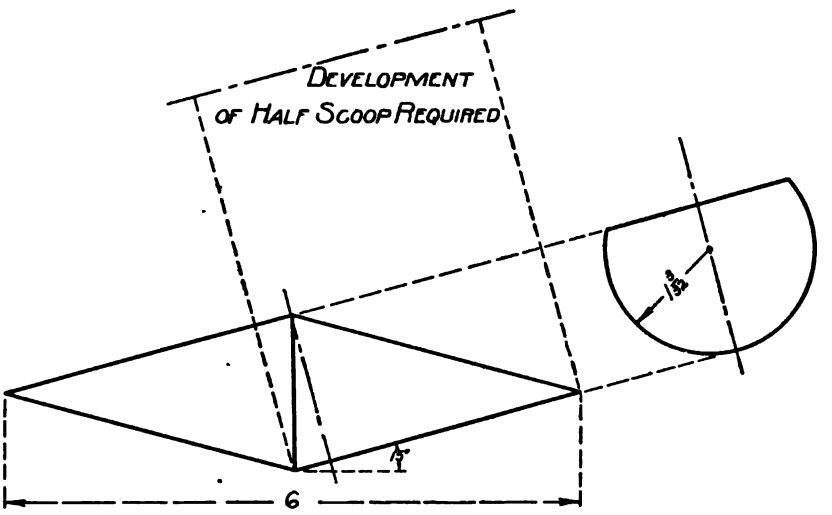


PLATE 71

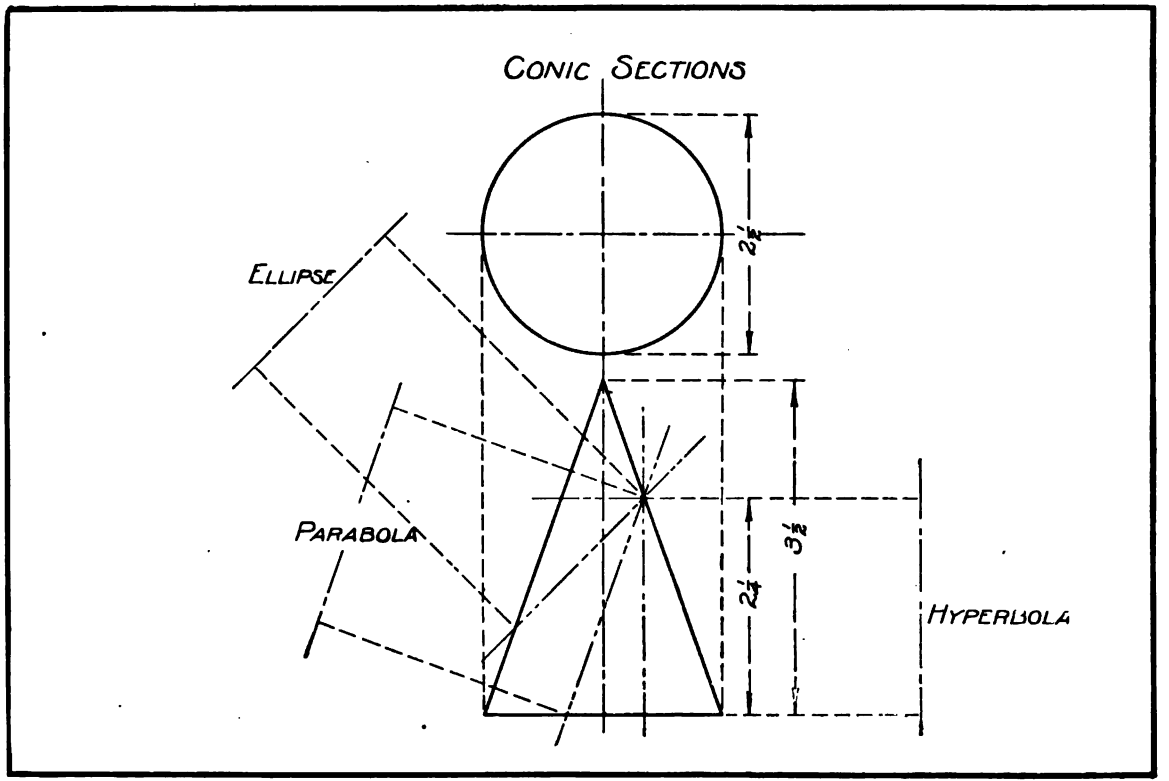


PLATE 72

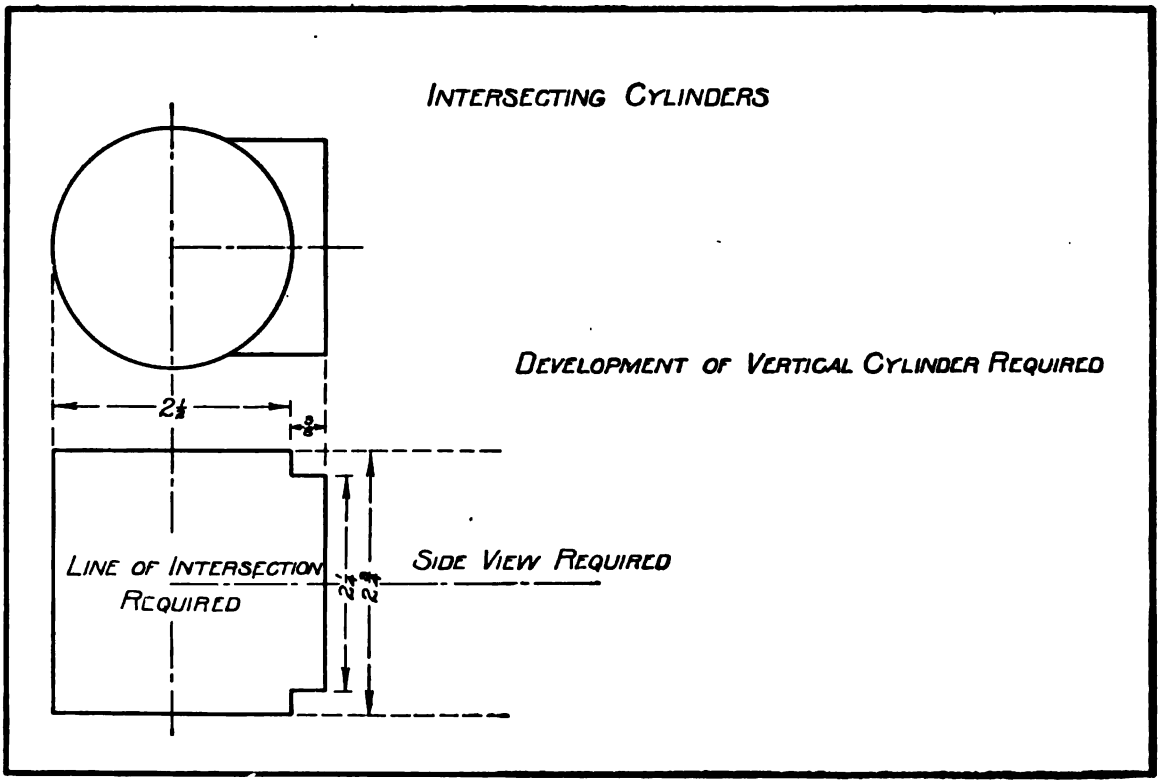

INTERSECTING CYLINDERS
DEVELOPMENT OF VERTICAL CYLINDER REQUIRED
2½
⅜
LINE OF INTERSECTION REQUIRED
2½
2½
SIDE VIEW REQUIRED

PLATE 73

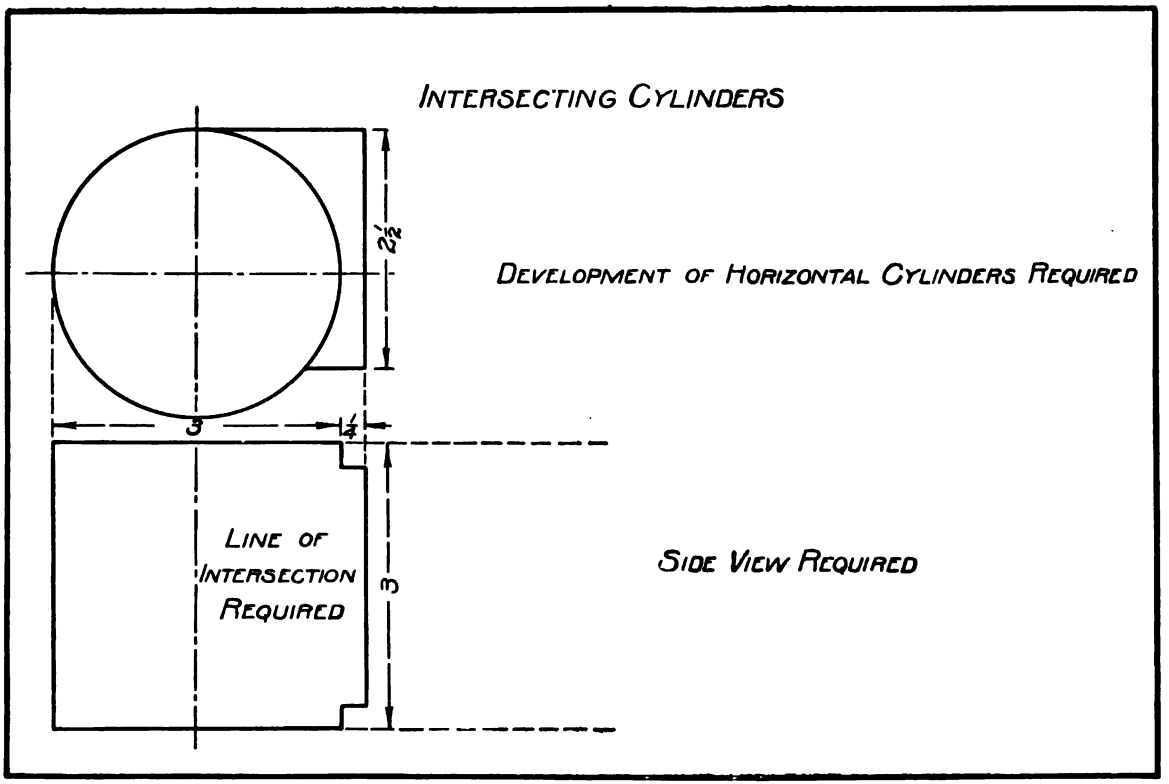
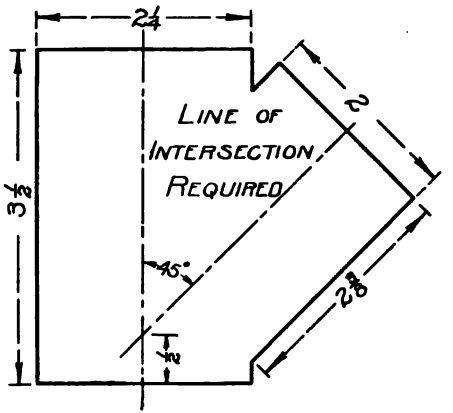

INTERSECTING CYLINDERS
2½
DEVELOPMENT OF HORIZONTAL CYLINDERS REQUIRED
3
¼
LINE OF INTERSECTION REQUIRED
3
SIDE VIEW REQUIRED

PLATE 74

INTERSECTING CYLINDERS

DEVELOPMENT OF 2 IN. CYLINDER REQUIRED

NOTE. THE DEVELOPMENT OF THE 2¼ IN. CYLINDER MAY BE MADE ON ANOTHER SHEET



SIDE VIEW REQUIRED

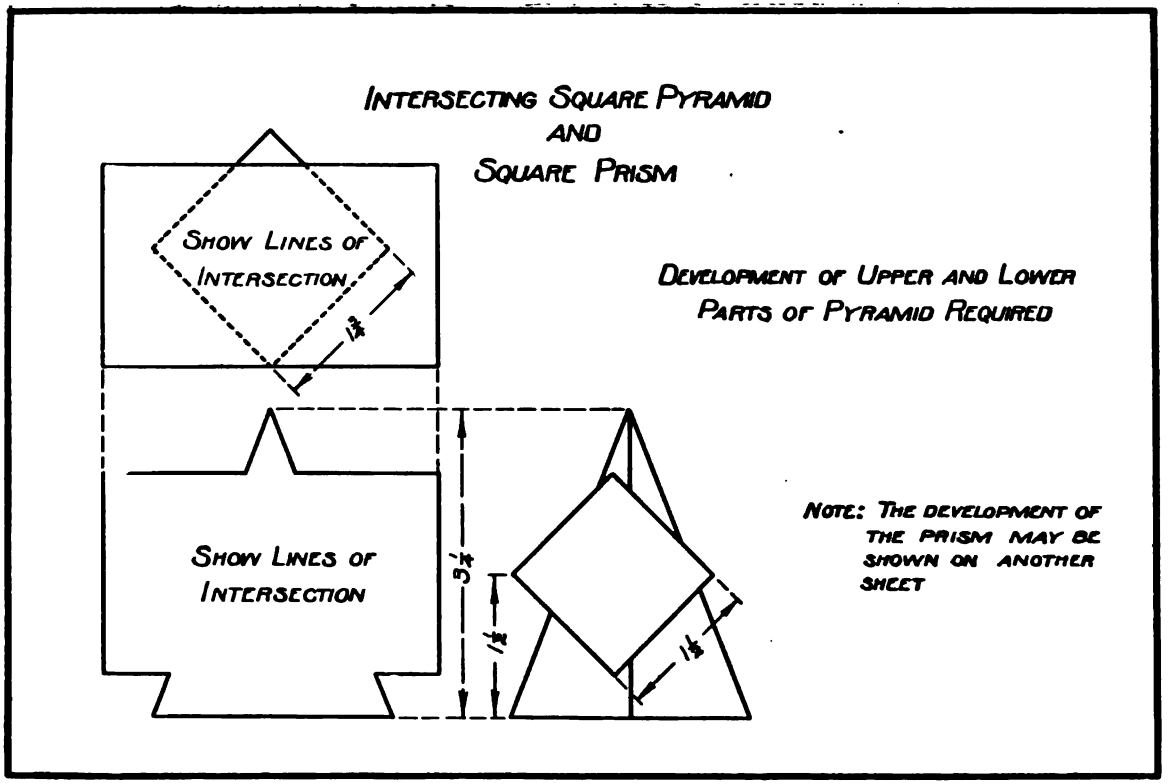

INTERSECTING SQUARE PYRAMID
AND
SQUARE PRISM
SHOW LINES OF INTERSECTION
1¾
DEVELOPMENT OF UPPER AND LOWER PARTS OF PYRAMID REQUIRED
SHOW LINES OF INTERSECTION
3¼
1½
1½
NOTE: THE DEVELOPMENT OF THE PRISM MAY BE SHOWN ON ANOTHER SHEET

PLATE 76

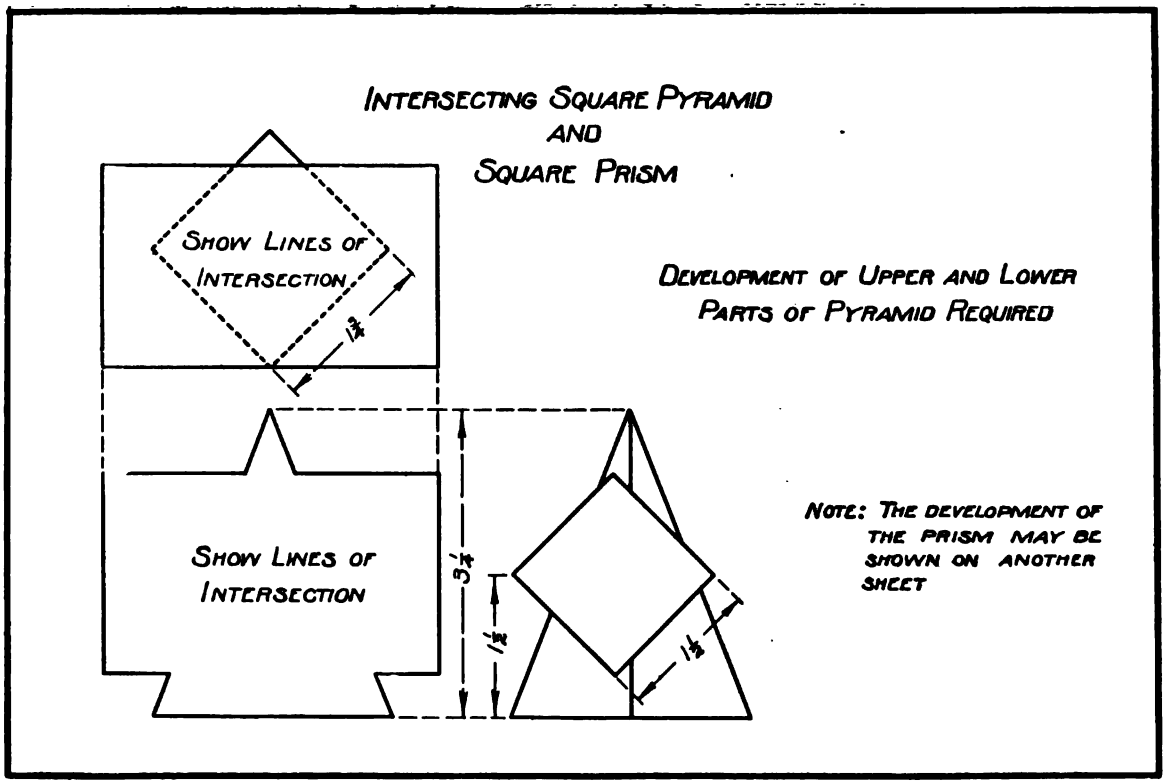
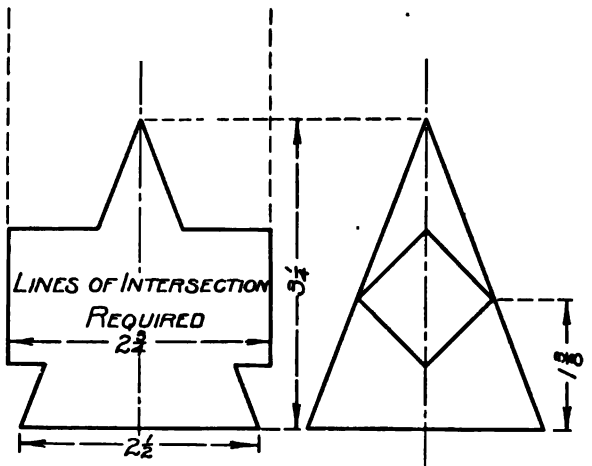

INTERSECTING SQUARE PYRAMID
AND
SQUARE PRISM
SHOW LINES OF INTERSECTION
1¾
DEVELOPMENT OF UPPER AND LOWER PARTS OF PYRAMID REQUIRED
SHOW LINES OF INTERSECTION
3¼
1½
1½
NOTE: THE DEVELOPMENT OF THE PRISM MAY BE SHOWN ON ANOTHER SHEET

PLATE 76

Intersecting Cone and Square Prism

Top View Showing
Lines of Intersection
Required

Development of Cone Required



Development of Prism Required

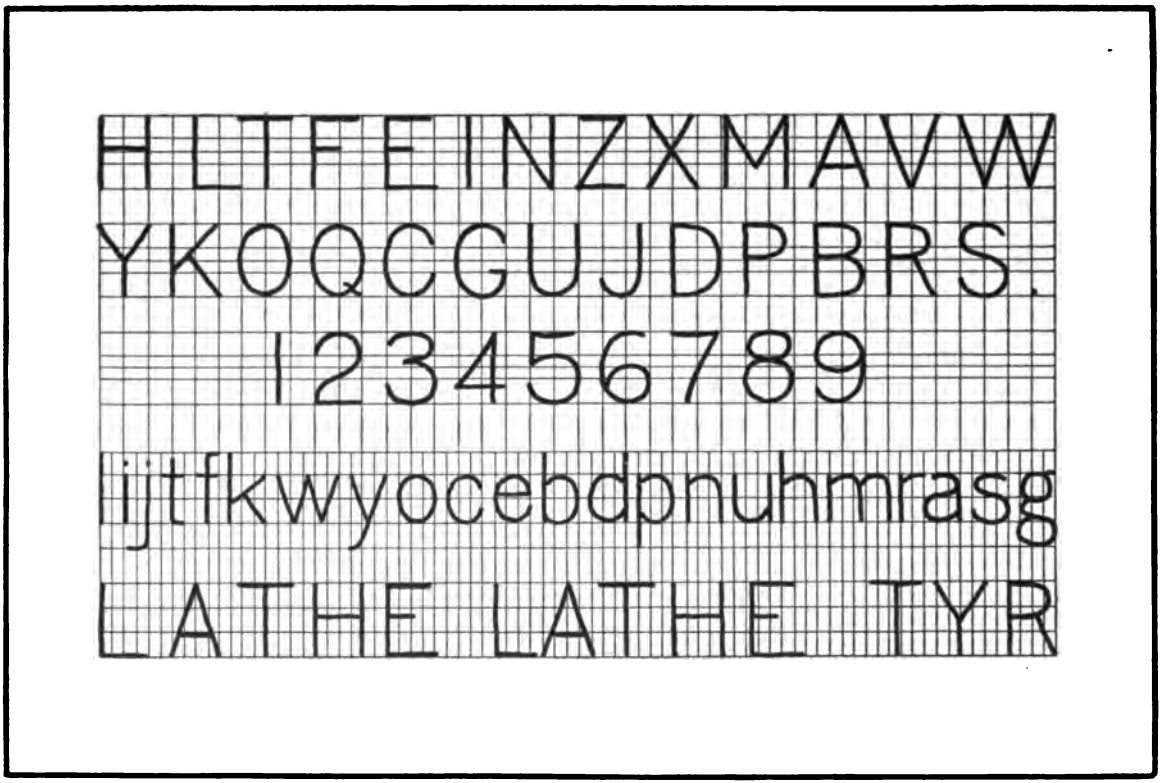

HLTFEINZXMAVW
YKOQCGUJDPBRS.
123456789
ijtfkwyocebdpnuhmrasg
LATHE LATHE TYR

PLATE 78

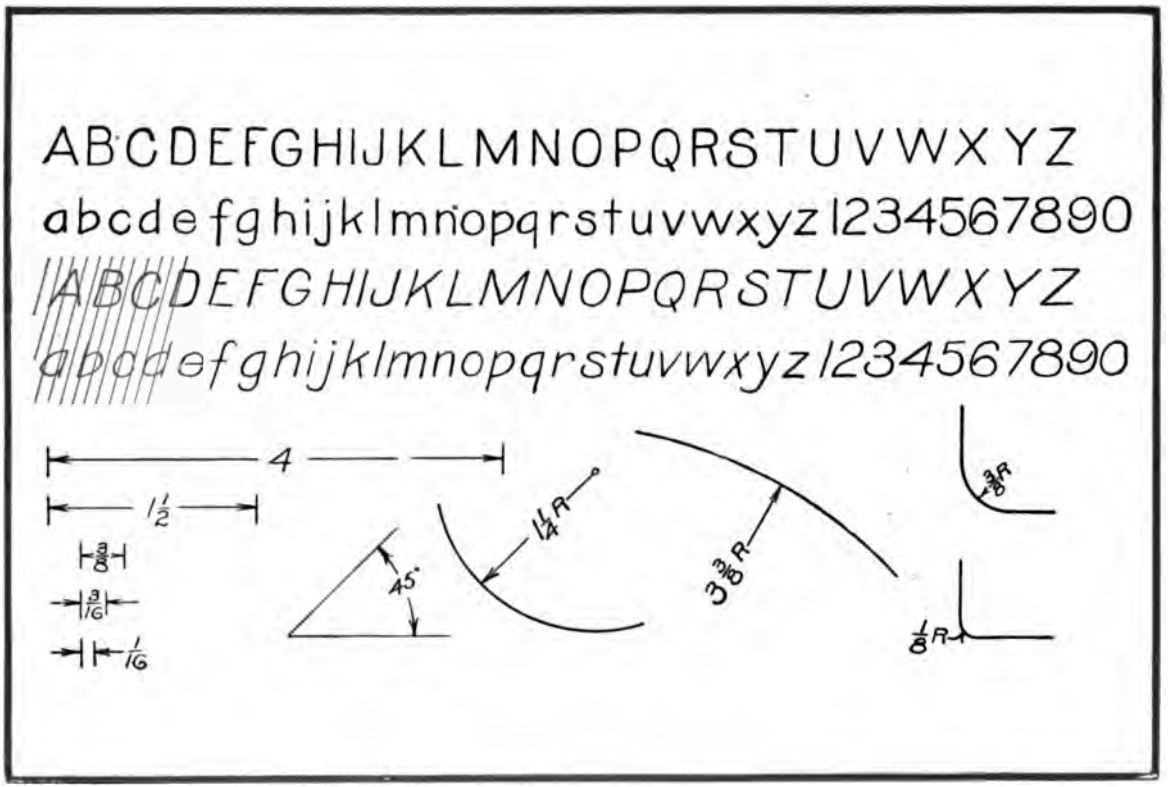

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890
4
1½
⅜
3/16
1/16
45°
1¼R
3⅜R
⅜R
⅛R

PLATE 79

XA

INK BOTTLE STAND

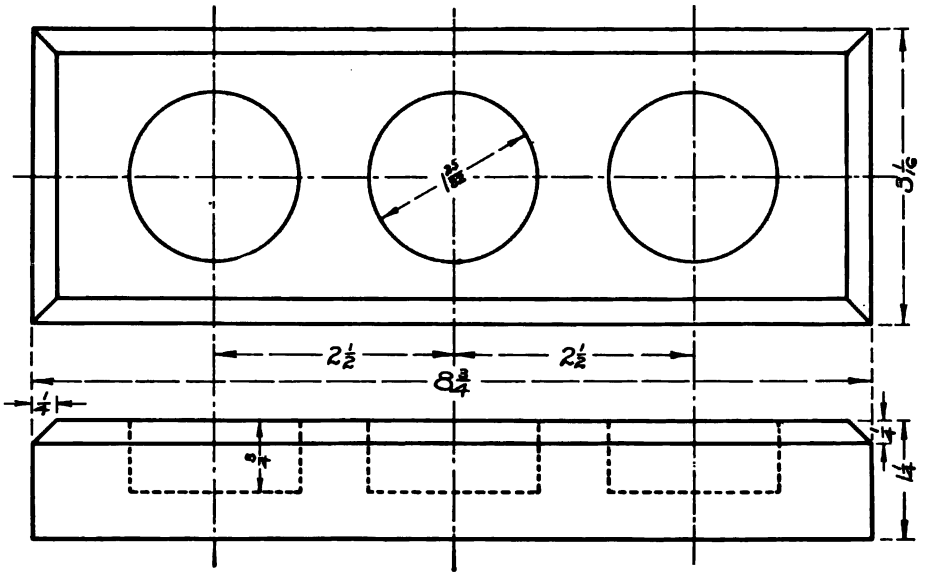


PLATE 80

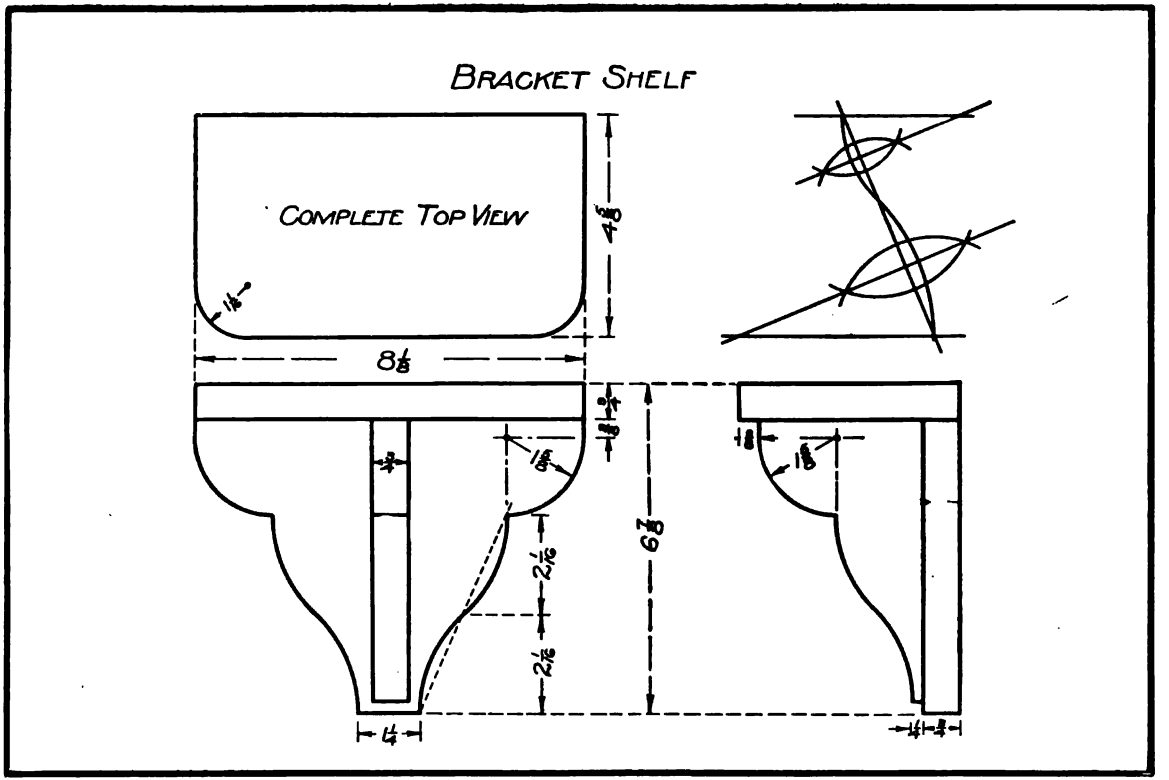


PLATE 81

TOWEL ROLLER

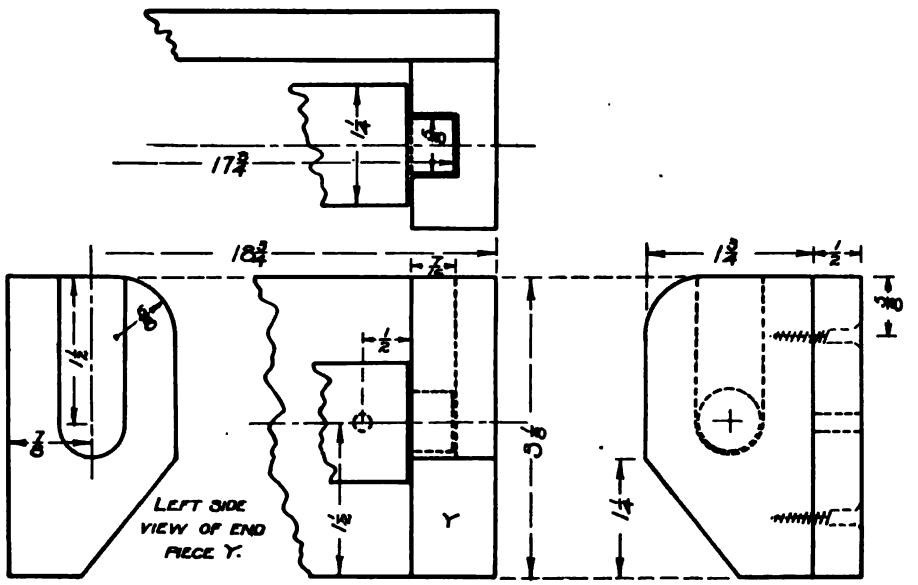


PLATE 82

XD

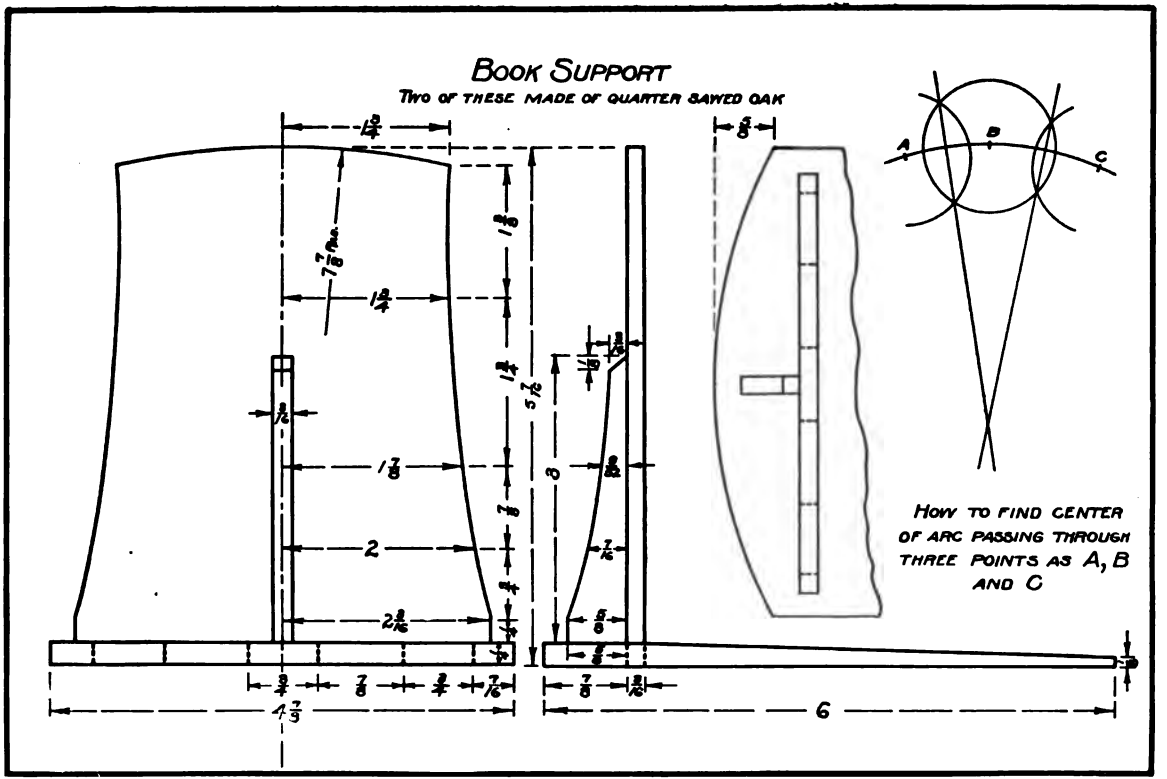
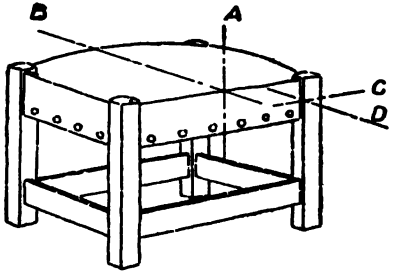

BOOK SUPPORT
TWO OF THESE MADE OF QUARTER SAWED OAK
HOW TO FIND CENTER OF ARC PASSING THROUGH THREE POINTS AS A, B AND C
A
B
C
6

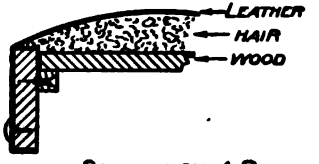
PLATE 83

LEATHER TOP STOOL.

MAKE WORKING DRAWING OF A LEATHER TOP STOOL 18 IN. LONG, 13 IN. WIDE AND 15 IN. HIGH, FOLLOWING THE SUGGESTIONS GIVEN IN THE ACCOMPANYING SKETCHES. MAKE DRAWING TO QUARTER SCALE.



SECTION ON C-D



SECTION ON A-B

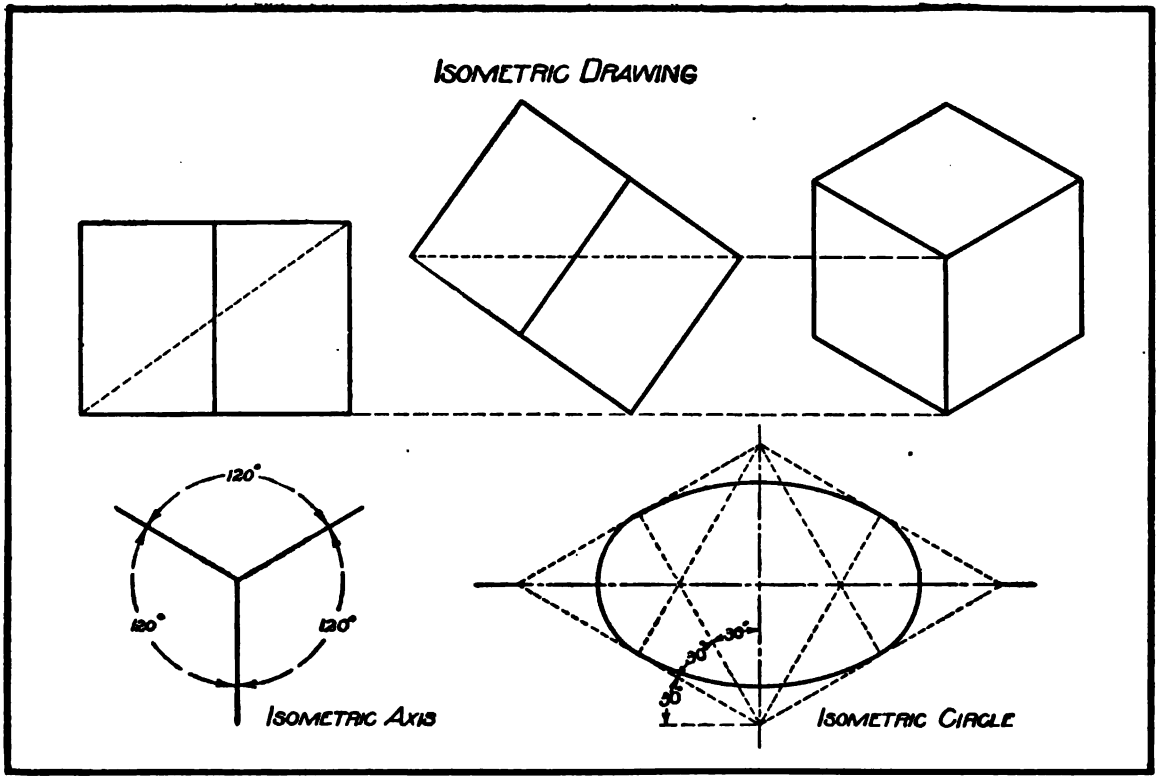

ISOMETRIC DRAWING
120°
120°
120°
ISOMETRIC AXIS
30°
30°
30°
ISOMETRIC CIRCLE

PLATE 85

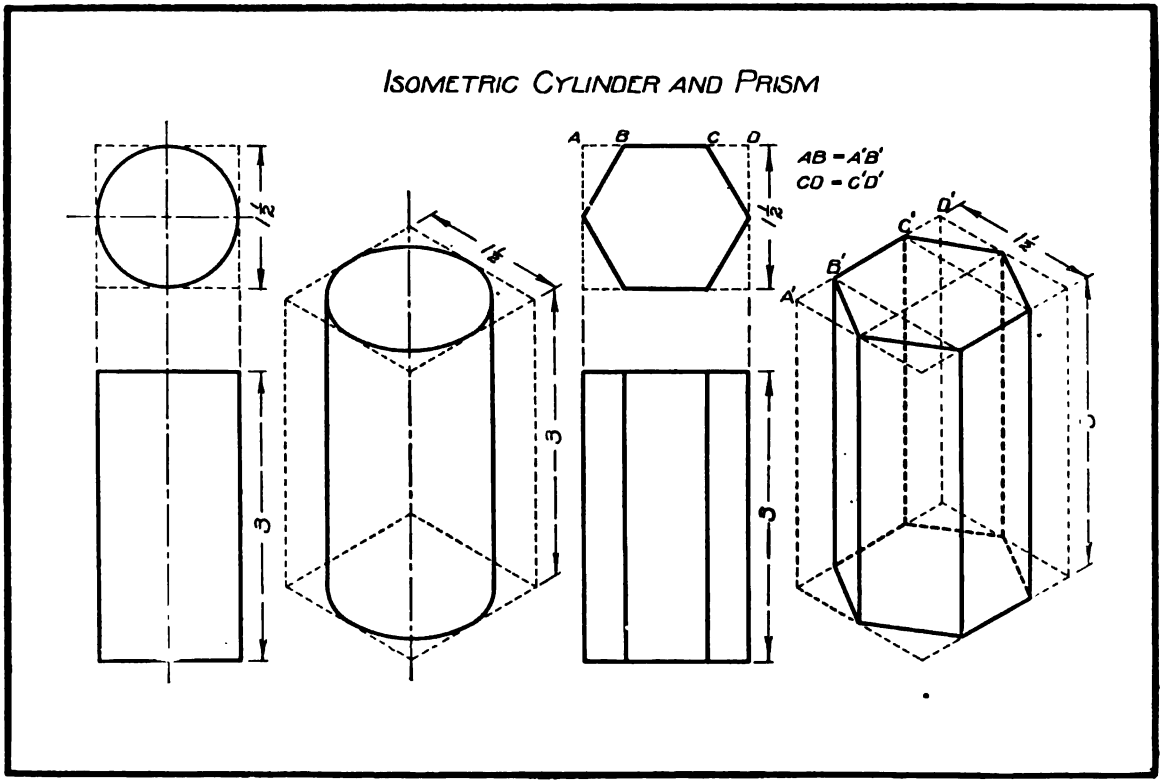
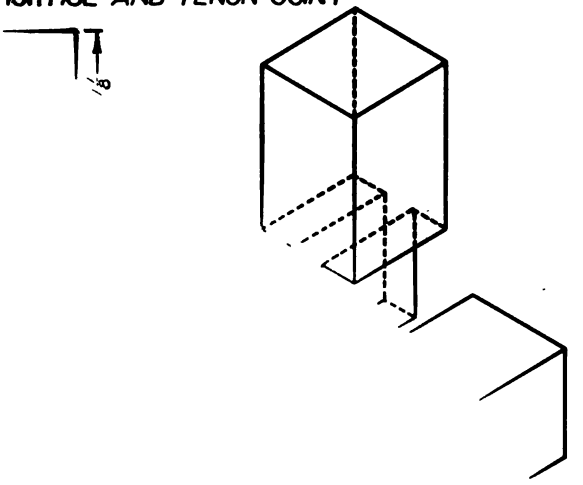

ISOMETRIC CYLINDER AND PRISM
A
B
C
D
AB = A'B'
CD = C'D'
A'
B'
C'
D'
1½
1½
1½
3
3
3
3

PLATE 86

Mortise-and-Tenon Joint



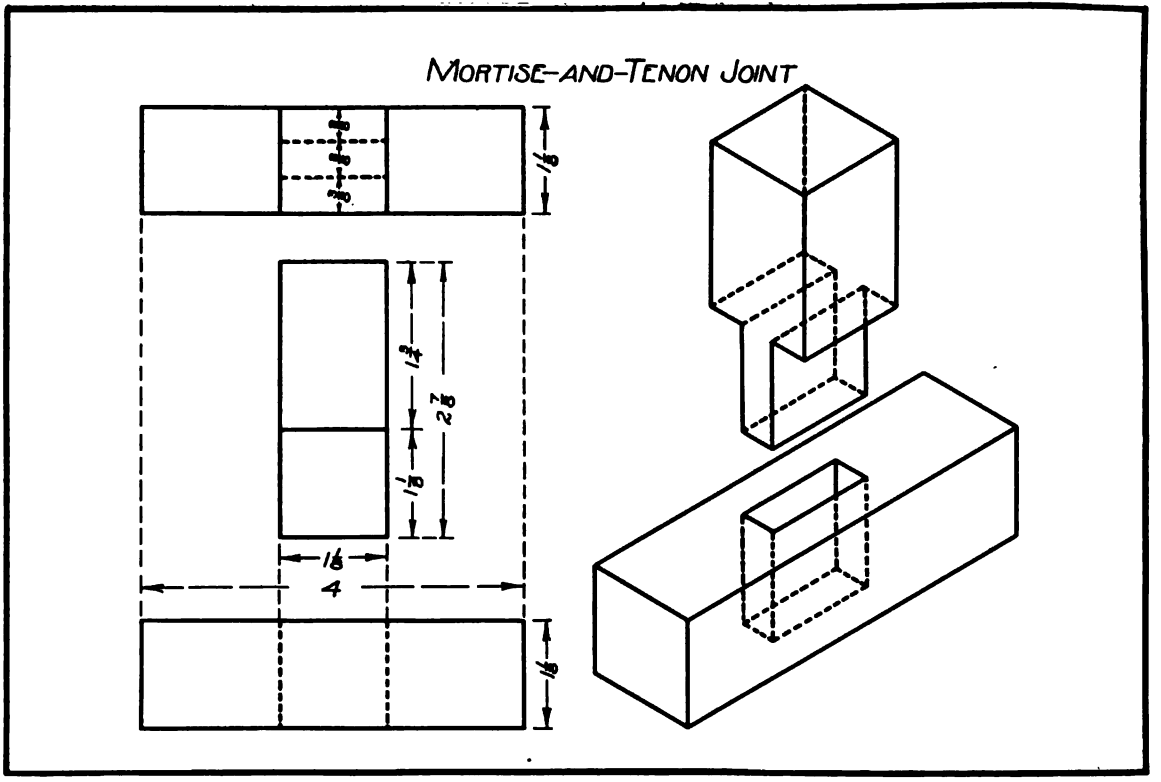


PLATE 87

MAKE AN ISOMETRIC DRAWING OF THE BOX, SHEET IF; OR THE TRY-SQUARE, SHEET IC; OR THE CRANK, SHEET IIID; OR THE BENCH SHAFT BOX, SHEET IIIF.

BOOKS ON THE MANUAL ARTS

HANDWORK IN WOOD by WILLIAM NOYES. A comprehensive and scholarly reference book written especially for teachers of woodworking. $2.00

WOOD AND FOREST by WILLIAM NOYES. A reference book on wood and the forest. Contains detailed descriptions with five illustrations each of 67 principal species of trees. $3.00

PROBLEMS IN FURNITURE MAKING by FRED D. CRAWSHAW. A book of 32 plates of working drawings and 24 pages of text including notes on the problems and chapters on design, construction and finishes. $1.00

PROBLEMS IN WOODWORKING by M. W. MURRAY. A collection of 40 full-page plates of working drawings of projects that have proven successful in the grades. 75 cents

CORRELATED COURSES IN WOODWORK AND MECHANICAL DRAWING by IRA S. GRIFFITH. A handbook for teachers on organization, lesson outlines and methods of teaching. $1.50

PROJECTS FOR BEGINNING WOODWORK AND MECHANICAL DRAWING by IRA S. GRIFFITH. A book of problems, with notes and directions, for Grades VII and VIII. 75 cents

ADVANCED PROJECTS IN WOODWORK by IRA S. GRIFFITH. Fifty plates of problems in furniture making for high schools. $1.00

ESSENTIALS OF WOODWORKING by IRA S. GRIFFITH. The standard students' textbook on woodworking. Adaptable to any course of projects. $1.00

PUBLISHED BY

The Manual Arts Press, Peoria, Illinois

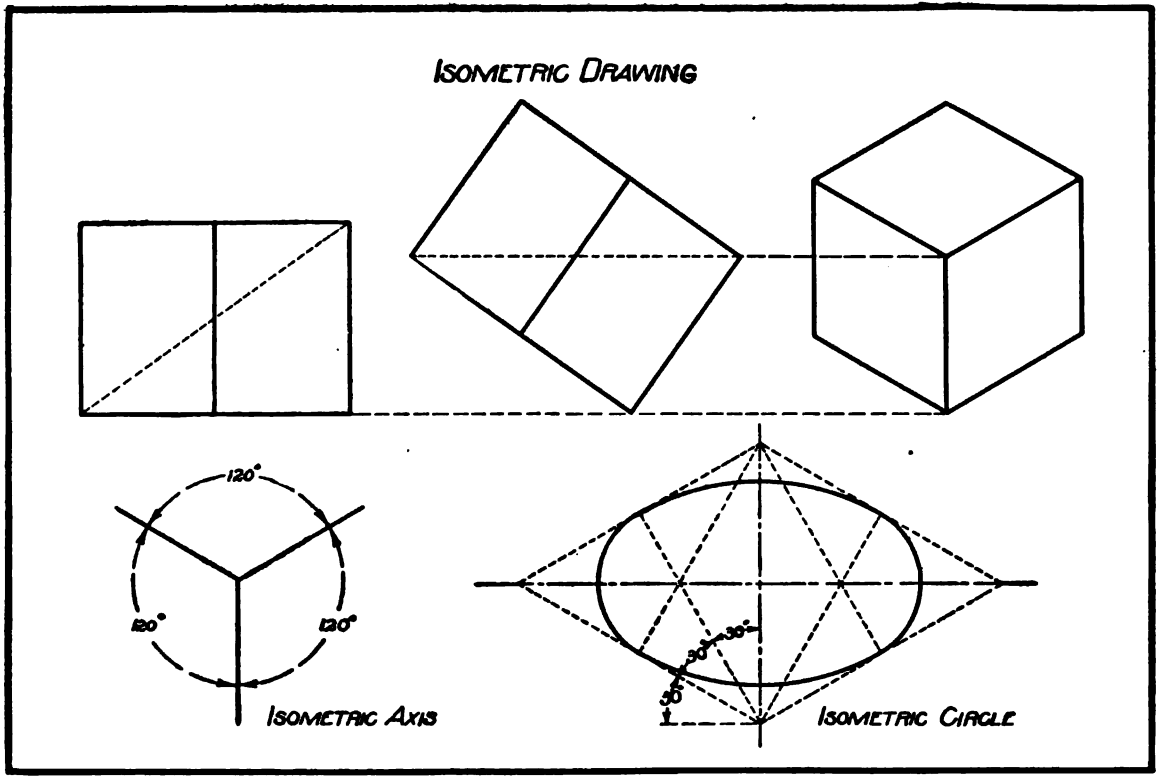

ISOMETRIC DRAWING
120°
120°
120°
ISOMETRIC AXIS
30°
30°
30°
ISOMETRIC CIRCLE

PLATE 85

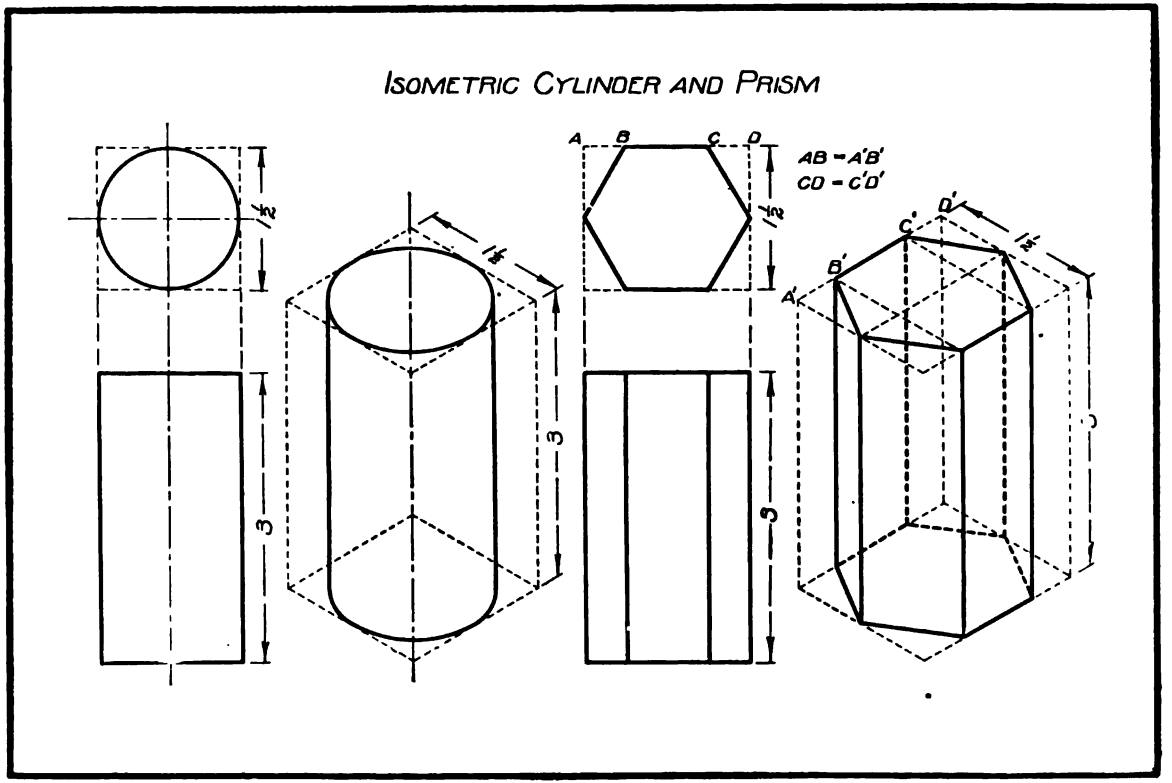

ISOMETRIC CYLINDER AND PRISM
A
B
C
D
AB = A'B'
CD = C'D'
A'
B'
C'
D'
1½
1½
1½
3
3
3
3

PLATE 86

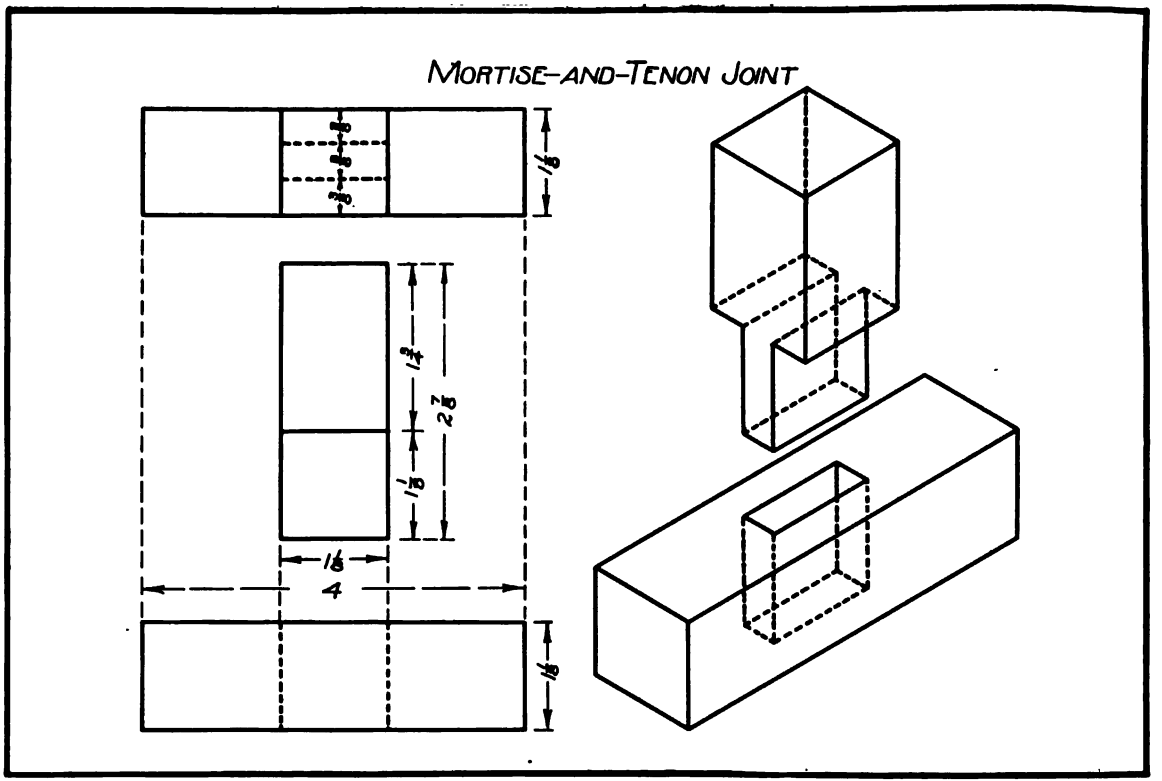


PLATE 87

XI D

MAKE AN ISOMETRIC DRAWING OF THE BOX, SHEET IF; OR THE TRY-SQUARE, SHEET IC; OR THE CRANK, SHEET IIID; OR THE BENCH SHAFT BOX, SHEET IIIF.

PLATE 88